CRANFIELD UNIVERSITY

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DEVELOPMENT AND ASSESSMENT OF A METHODOLOGY FOR THE IMPLEMENTATION OF STRATEGIC MANUFACTURING INITIATIVES

SCHOOL OF INDUSTRIAL AND MANUFACTURING SCIENCE

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Abstract

The competitiveness and growth in the manufacturing sector is critical for the UK economy. It is imperative that the design and improvement of manufacturing systems is a constant and dynamic task in the British manufacturing environment. Unfortunately, many companies are still facing major difficulties during the implementation of strategic decisions derived from the formulation of manufacturing strategies. Current project management methodologies and techniques provide inadequate support for managers facing the implementation of strategic manufacturing initiatives (SMI). Therefore, the intention of this research is to provide a rigorous and successful SMI implementation methodology whose structure and contents include the most critical aspects relevant to the strategic manufacturing environment.

The research described in this thesis has set out to form a SMI implementation methodology through a structured research programme. Initially existing literature related to SMI implementation methods was reviewed and analysed. A pilot methodology was then formed by contrasting literature against a list of key success factors in the implementation of strategic manufacturing initiatives determined from a worldwide survey. The pilot methodology was evaluated by a selection of practitioners, and results were used to refine the methodology. Finally, a validation test in a manufacturing organisation was conducted through a case study demonstrating the feasibility, usability and usefulness of the methodology. The fully tested and refined methodology is presented as a workbook in the appendix of this thesis.

The outcome of this research is a structured step by step methodology which is an aid to the implementation of strategic manufacturing initiatives. The work described in this thesis has made a significant contribution to the knowledge on how to go about the implementation of strategic manufacturing initiatives.

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Notation

ADM	Arrow Diagramming Method
APM BOK	Association of Project Management Body of Knowledge
APM	Association of Project Management
BS	British Standard
BSI	British Standards Institute
CASE	Computer-Aided Software Engineering systems
CCTA	Central Computer and Telecommunications Agency
CT	Control Techniques
DTI	Department of Trade and Industry
EVM	Earned Value Management
GDP	Gross Domestic Product
KSF	Key Success Factor
NIMSAD	Normative Information Model-Based System Analysis and Design
OGC	Office of Government Commerce
PDM	Precedence Diagramming Method
PM	Project Management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMIS	Project Management Information System
PMP	Project Management Plan
PRINCE	Projects In Controlled Environments
SMI	Strategic Manufacturing Initiative
SOW	Statement Of Work
SPM	Strategic Project Management
SSADM	Structured Systems Analysis and Design Method
UK	United Kingdom
WBS	Work Breakdown Structure

Chapter 1: Introduction

Although the implementation of manufacturing strategy through a number of strategic manufacturing initiatives is one of the key tasks for the success of manufacturing organisations and the competitiveness of the national manufacturing industry, the literature is sparse and very little work has been reported on the process and content of this managerial activity. This Chapter introduces the background of the research, followed by an overview of the aim, objectives and the research programme adopted. Then a summary of the research findings and contribution is presented.

1.1 Background to the Research

Today's manufacturing environment is complex, almost everywhere organisations are undergoing rapid and significant changes driven by customer expectations, new technologies, and growing global competition (Section 2.1). As a result, many manufacturing processes within organisations have to be dynamic and constantly changing. In order to survive in such dynamic environments, practitioners are forced to continually develop and implement strategic initiatives highly relevant to the future success of the manufacturing function (Section 3.1).

A strategic manufacturing initiative (SMI) is a major manufacturing effort that will have a sizeable impact on either the manufacturing external competitive edge, its internal capabilities or its financial performance – or all three (Section 3.1.1). SMIs provide a mechanism for aligning the capabilities of the manufacturing function with the strategic direction taken by the company (Section 3.2). The benefits and capabilities gained by realising a manufacturing strategy (Section 3.1) may only result if the implementations of many SMIs that form the manufacturing strategy are successful (Section 3.2).

Over the last few years there has been increasing interest in the research of new methods to improve the efficiency of strategy implementation (Section 3.3). Whereas practitioners need efficient methods for managing the successful and rigorous implementation of strategies in their business sector, a project oriented approach has been identified as a more efficient process to manage the implementation of strategic initiatives (Section 3.3).

There are some generic project management methodologies and tools available to help manufacturing organisations implement their strategic initiatives, however, many companies are still facing major difficulties during the implementation of strategic decisions. The project management knowledge base at present is too wide and poorly structured (Section 3.4). The concepts and the whole structure and content of generic project management methodologies give very little treatment to many relevant issues in the context in which practitioners operate today in the strategic manufacturing area (Section 3.4). In this context, the use of an inappropriate methodology could result in overall project failure (Section 3.4). Hence, the research aim and objectives have been formulated (Section 4.2) and a summary is presented in the next section.

1.2 Overview of Research Aim, Objectives and Programme

As developed in Section 4.2, the aim of this thesis has been stated as:

> "*to develop a methodology to guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives.*"

In order to fulfil the research aim, 4 research objectives have been defined as:

1. Review existing literature on methodologies for the implementation of strategic manufacturing initiatives.
2. Identify critical success factors in the practical implementation of strategic manufacturing initiatives in industry.
3. Develop a method for the implementation of strategic manufacturing initiatives.
4. Evaluate and refine the methodology through practitioners' assessment and practical application in industry settings.

The research programme has been divided into 6 stages in order to deliver the research aim and objectives. Stages 1 to 3 of the programme will concentrate on the formation of the SMI implementation methodology (Chapters 5, 6 and 7). These stages will enable the researcher to review significant methodologies in literature related to SMI implementation, identify the critical success factors in the implementation of SMIs in practice, and form the proposed methodology. The focus of stages 4 to 6 will be on the assessment and evaluation of the methodology (Chapters 8, 9 and 10).

1.3 Overview of Research Findings and Contribution

The following summarises the outcomes from the main stages of the research programme:

- The 36 key success factors in the implementation of strategic manufacturing initiatives have been determined.
- A review of existing project management methodologies against the key success factors identified indicated a lack of a rigorous methodology for the successful implementation of strategic manufacturing initiatives.
- A methodology that provides a rigorous process for the successful implementation of strategic manufacturing initiatives has been formed.

The research presented in this thesis makes two main contributions to knowledge on the subject of implementing strategic manufacturing initiatives. The main outcome of this research is the creation of a methodology to provide practical and procedural aid for SMI implementation efforts. The purpose of the methodology developed in this thesis is to guide the practitioner through a series of well-defined steps necessary to succeed in the implementation of a strategic manufacturing initiative. The secondary contribution is new knowledge on the degree and order of criticality of key success factors when implementing strategic manufacturing initiatives.

1.4 Structure of the Thesis

The thesis structure is illustrated in Figure 1.1 and contains the following principal sections:

Chapter 2 Reviews the industrial context showing the difficulties that many practitioners and a typical UK manufacturing organisation are facing when dealing with the implementation of strategic manufacturing initiatives and the repercussions of failing in the implementation of SMIs for the UK manufacturing industry and the whole UK economy.

Chapter 3 Reviews the literature in order to define the concepts of strategic manufacturing initiative and establishes the importance of successful SMI implementation and how strategic manufacturing initiatives can be implemented. Current research issues are also discussed to establish limitations and gaps in the current knowledge.

Chapter 4 Provides an overview of the research problem and develops the research aim, objectives and programme. Individual stages of the work are determined, and for each stage, a suitable research method is identified.

Chapter 5 Reviews the literature in order to identify existing methodologies related to the implementation of SMIs. Existing methods are reviewed in terms of a seven-category system, presenting their similarities and differences.

Chapter 6 Reviews the literature in order to identify potential critical factors in the implementation of SMIs and reports on the study of identifying the key success factors in the implementation of strategic manufacturing initiatives in practice.

Chapter 7 Develops the pilot SMI implementation methodology by assessing methodologies from literature against the key success factors identified in the study of practitioners. It also discusses the operational application and delivery medium for the proposed methodology.

Chapter 8 Reports the primary evaluation of the SMI implementation methodology by seeking practitioners' opinions using a semi-structured interview research method. The findings of the evaluation resulting in a number of changes to the methodology are also discussed.

Chapter 9 Reports the results of a case study into the use of the methodology in a typical UK manufacturing organisation. The results of the test provide confirmation of the feasibility, usability and usefulness of the methodology.

Chapter 10 Presents and describes the final methodology. It presents the formation process and describes the structure, content and relationship between the methodology, the key success factors identified and other issues raised during the evaluation and case study.

Chapter 11 Concludes this thesis with a discussion of the principal research findings against research aim, contributions to knowledge, and limitations of the research programme and findings. It finally discusses the future research directions that could follow from this research.

This chapter has provided an overview of the research background, the research aim, objectives and programme, a summary of the research findings and contribution, and the thesis structure. In the next chapter, an overview of the industrial context in the area of strategic manufacturing implementation is presented.

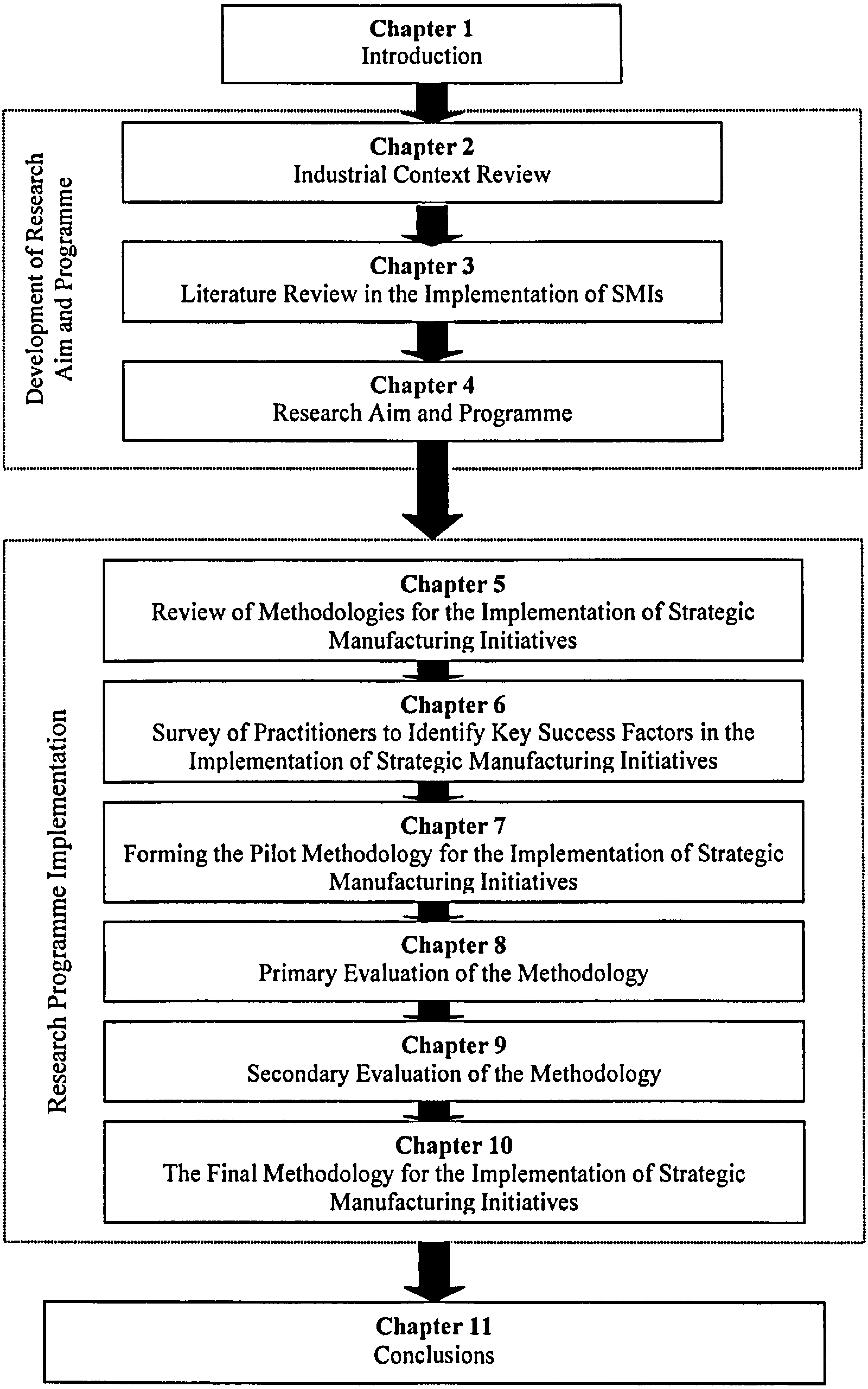

Figure 1.1: The Structure of the Thesis

Chapter 2: Industrial Context Review

Chapter 1 has set out the background to the research, and an overview of the research aim, objectives and programme, followed by a summary of research findings and contribution. This chapter deals with the industrial context of the research, emphasising the importance of manufacturing within the UK economy, introducing the sponsoring organisation, and presenting the challenge of implementing strategic manufacturing initiatives in a typical UK company.

2.1 Manufacturing within the UK Economy

Manufacturing represents a leading sector in the economy of developed capitalist countries. The very separation of a number of capitalist countries into a group of 'developed' countries is in great measure conditioned by the level of their industrial development. Manufacturing industry has always been considered the major factor in the economic development of capitalist countries (Artobolevskiy et al., 1984).

Manufacturing is by far the largest single contributor to the global economy accounting for nearly three quarters of the World's trade (DTI, 2000). According to Artobolevskiy et al. (1984), manufacturing is linked with the general economic development of a country or a region in two ways - directly and indirectly. The direct link is the immediate participation of industry in the creation of a final product or national income, while the indirect link is the influence of industry on other spheres of the economy via production and information links. This argument is reinforced by DTI (2000), which claims that what is often overlooked is that other sectors in the UK are interlinked with manufacturing and could not exist without it. Many service sectors, such as wholesale and retail distribution, maintenance and aftersales, have manufactured goods as their raison d'être – and these services contribute further to GDP.

Manufacturing is a significant component of the UK economy. It adds to the well-being of the nation by fundamentally affecting employment, wealth creation, international standing and quality of life (DTI, 2000). The UK is a major manufacturing nation with an exceptional number of large international companies, many of which are world leaders. According to the Trade and Industry Committee (1994), the UK is the fifth largest exporter of manufactures in the world. The manufacturing industry in the UK provides around 20% of gross domestic product (GDP) and over 60% of UK exports, compared to less than 25% in the case of services. In addition, 25% of manufactured output is exported, compared with 11% to 14% of service industry output (Trade and Industry Committee, 1994).

The growth in the UK's manufacturing sector should be viewed primarily as a way of increasing the creation of national wealth (Trade and Industry Committee, 1994). In a global manufacturing society, the UK is in direct competition with other countries to be the base for individual companies' operations, both regionally and globally. For the UK to succeed in the face of this competition, it must get much closer to their customers and to operate far more responsively than they have in the past (DTI, 2000). Unfortunately, in recent decades the UK manufacturing industry has resembled the experience of other major industrial countries. Manufacturing's share of GDP in constant 1985 prices in the UK has declined in the 1970s and 1980s as shown in Table 2.1, while that of service industries has risen. The percentage of employment in manufacturing has also declined during the 1970s and 1980s (Trade and Industry Committee, 1994).

CONSTANT 1985 PRICES				
Manufacturing's share of GDP (%)			% change p.a.	
1970	1980	1990	1970-80	1980-90
27.5	22.2	20.1	-2.1	-0.7

Table 2.1: Shares of UK Manufacturing in GDP (source Trade and Industry Committee, 1994)

In order to compete for a share in this international market, UK manufacturing companies need to reassess their products in relation to emerging markets and world-class competition and set their individual roads to new manufacturing strategies derived from the particular needs of each business (DTI, 1988). Ultimately, these strategies will have to be successfully implemented in order to realise the desired benefits and future competitiveness of the UK manufacturing industry. The UK manufacturing industry has been classified based on two criteria: Firstly, the composition of its manufacturing output as shown in Figure 2.1; Secondly the structure of UK manufacturing by size of firm as shown in Table 2.2.

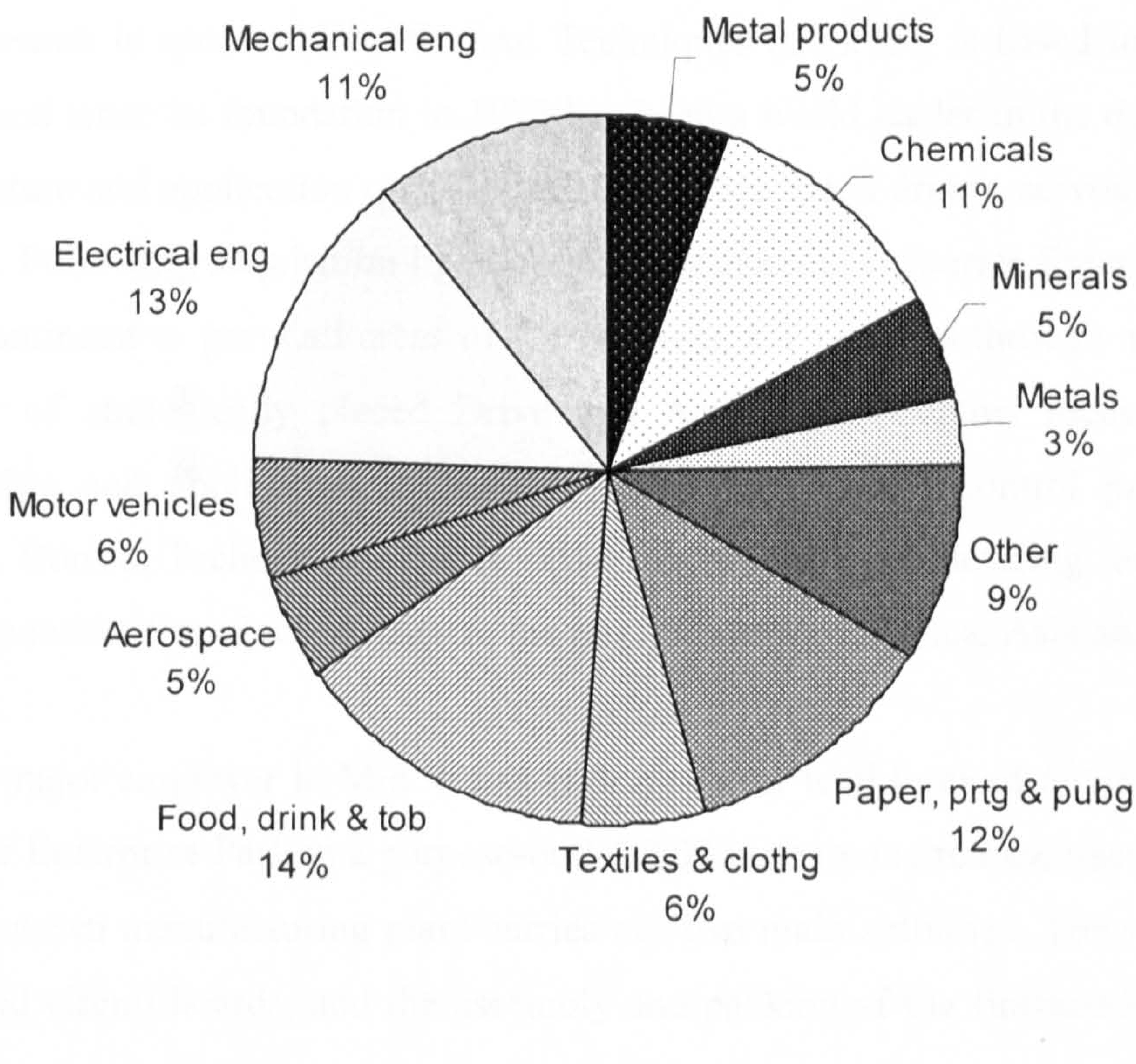

Figure 2.1: Sectoral Breakdown of UK Manufacturing Output (source Trade and Industry Committee, 1994)

No. of employees per firm	No. of firms	Total employment (thousands)	Total employement (%)	Gross output (%)
1-99	123,208	1,157	26	18
100-499	3,594	730	16	14
500-4,999	1,006	1,299	29	31
5,000-19,999	83	712	16	20
20,000 & over	16	608	13	17
TOTAL	127,907	4,506	100	100

Table 2.2: UK Manufacturing by Size of Firm in 1991 (source Trade and Industry Committee, 1994)

2.2 Control Techniques as a typical UK Manufacturer

This research is sponsored by Control Techniques (CT). CT is based in Newtown, Wales, and since its foundation in 1973 has been a world leader in the development, manufacture and application of AC and DC variable speed drives, servos and control systems. Following acquisition by American engineering corporate Emerson in 1995 it has continued to grow all areas of the business. CT operates through a worldwide network of strategically placed Drive and Application Centres focussed on the distribution and application of variable speed and motion control products and systems. Control Techniques exports 92% of its annual manufacturing revenue of 90 million pounds in production sales to the rest of Europe, America, Asia and Africa.

CT is a major employer in Mid Wales with a current workforce of 520 based on the Mochdre Enterprise Park in a purpose-built 13,000 square metre manufacturing plant. The Newtown manufacturing plant carries out two main activities: The manufacture of printed circuit boards, and the assembly and packing of the finished product (the drive).

In order to define CT within the UK manufacturing industry, the classification presented in the previous section has been employed. Based on the sectoral breakdown of the UK manufacturing output presented in Figure 2.1, CT is part of the

Electrical Engineering sector, which counts for 13% of UK manufacturing output. With regard to the UK manufacturing classification by size of firm in 1991 shown in Table 2.2, CT is included in the 1,006 firms with a number of employees between '500-4,999'. This group of companies counts for the highest percentage of total employment in manufacturing (29%) and the highest contribution to the gross output (31%). As a typical UK manufacturing organisation, the performance of the manufacturing function is critical for CT in terms of the strategic competences that help CT to win orders and maintain existing customers.

2.3 The Challenge of Strategic Manufacturing Initiative Implementation within Control Techniques

During the last decade Control Techniques has faced the implementation of multiple strategic manufacturing initiatives (SMI) in order to increase its competitiveness in the marketplace and ultimately to further increase its profitability. In 1995 the strategic vision was the creation of a fully automated system. In 2002 the strategic manufacturing direction for the manufacturing operations was to create a truly lean and flexible system, excelling in terms of low inventory and high flexibility against changes in customer demand.

Regardless of the manufacturing strategy and the manufacturing capabilities intended to acquire, the implementation processes of such initiatives have been project based tasks because they have involved most areas of the business that needed to be coordinated in order to achieve the desirable results. Project managers have been internally allocated and each project manager has followed his self-developed way to project manage the implementation of the selected SMIs. They report to Senior Management, Directors and Vice-President of Operations who in a rather informal approach evaluate the rates of success for every project.

In September 2000 CT was looking for a project manager responsible for the implementation of all Lean initiatives. This time CT needed to search outside the organisation for the skills and the lean manufacturing knowledge required. CT was looking for excellence and, therefore, integrating academic research and industrial practice was seen as a major advantage.

During the first six months two facts were becoming increasingly clear for the researcher: Firstly, the research in the content and process of Lean manufacturing was already wide and deep and further research didn't seem to lead to additional contribution to the success of the company nor to the body of knowledge; secondly, it was not possible to find a rigorous piece of work in literature that was based on the manufacturing environment which would help to succeed in managing projects of the nature of the implementation of SMIs.

Over the years, the blame of bad results from SMI implementation projects has been attributed to, from the senior management point of view, the lack of efficient project managers and, from the project managers point of view, the lack of support and an inappropriate project performance assessment. Both parts are probably right. SMIs are not large construction, engineering, or IT software development projects that can be successfully implemented based on well documented and researched project management guidelines and workbooks.

A methodology to guide the implementation of SMIs should provide a framework based on the manufacturing environment that would include repeatable processes and techniques to greatly increase the odds of success and to provide value to the project, the project manager, and to the manufacturing organisation. Therefore, providing such a structured methodology for the implementation of strategic manufacturing initiatives is the purpose of this research.

2.4 Chapter Summary

This Chapter has set out the importance of the manufacturing industry to the UK economy and two classifications of UK manufacturing organisations have been described. Control Techniques, the sponsoring organisation, has been introduced as a typical UK manufacturer based on the classifications presented. Finally, the industrial case for CT has been described as the lack of an appropriate methodology that would guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives.

Chapter 3: Literature Review on the Implementation of Strategic Manufacturing Initiatives

The motive of this research is to provide support for manufacturing organisations in the implementation of strategic manufacturing initiatives (SMI). The purpose of this chapter is to give an overview of strategic manufacturing concepts and to explore the issues that currently constrain the successful implementation of strategic initiatives based on project management methodologies. To achieve this, the following questions are addressed.

1. What is a strategic manufacturing initiative?
2. Why is the successful implementation of strategic manufacturing initiatives important?
3. How should strategic manufacturing initiatives be implemented?
4. What are the current research issues associated with the implementation of strategic manufacturing initatives?

3.1 The Concepts of Strategic Manufacturing Initiative

The intention of this section is to answer the question, "What is a strategic manufacturing initiative?" The key to this understanding is in the concepts of manufacturing strategy (Section 3.1.1), the concepts of manufacturing strategy process and content (Section 3.1.2), and the definition of strategic manufacturing initiative (Section 3.1.3). This section therefore seeks to explore these core elements. A description of each concept is presented in the next three sections.

3.1.1 The Concepts of Manufacturing Strategy

Before dealing with the concepts of 'manufacturing strategy' it is necessary to consider the meaning of the terms 'strategy' and 'business strategy'. Unfortunately there is little agreement amongst either practitioners or academics (Slack et al, 2001). There are several views on what 'strategy' means. Representative definitions include:

> "*the skill in managing or planning*" (Agnes, 2003)

> "*the primary means of reaching the focal objective. The focal objective is whatever objective is in mind at the moment. Strictly speaking it is literally meaningless to talk about strategy without having an objective in mind. Viewed in this context strategy becomes an integral part of the ends-means hierarchy*" (Thorelli, 1977)

According to Platts (1990), the first definition of modern day 'business strategy' was formally defined by Chandler (1962) as:

> "*the determination of the basic long term goals and the objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals.*"

Other definitions of business strategies include:

> "*the direction and scope of an organisation over the long term. It ideally matches its resources to its changing environment, and in particular its markets, customers or clients so as to meet stakeholder expectations*" (Johnson and Scholes, 1993)

> "*the total pattern of decisions and actions that position the organization in its environment and that are intended to achieve its long-term goals*" (Slack et al, 2001).

In order to define the term 'manufacturing strategy' it is necessary to understand the strategic impact of the manufacturing function in the success of an organisation. Unfortunately this link has not always been apparent. Manufacturing strategy has been a neglected topic of discussion for many years although manufacturing strategies have been devised informally for centuries. Darlow (1999) summarised the research of informal manufacturing strategies in literature providing examples present in history such as:

- The development of factory layouts and power sourcing in the late eighteenth century (Black, 1998)
- The changes in labour practices during the early nineteenth century (Nevings and Whitney, 1989)
- Manufacturing developments into and through the mass production era (Schonberger, 1982)

In the past, despite the existence of informal manufacturing strategies that had a significant impact on the performance and capabilities of organisations, the manufacturing function was regarded merely as a collection of resources and constraints (Skinner, 1969). It was expected to fulfil, as efficiently as possible, the production targets generated by the marketing strategy within the capacity and capital expenditure constrains imposed by the financial strategy (Skinner, 1969).

Skinner was the first to observe that a company's manufacturing function could do more than simply produce and ship the products. Since Skinner's 1969 article, "Manufacturing – Missing Link in Corporate Strategy", one of the reasons for the loss of a competitive edge by western manufacturing businesses became increasingly apparent. Manufacturing had long been regarded as the poor man of the company functional hierarchy. It was perceived as dirty, noisy, and the realm of the technicians. In consequence, senior management avoided involvement in manufacturing, decisions were taken on a tactical basis by specialists who were not necessarily aware of overall corporate strategy, and instead of being a valuable asset and a tool of corporate strategy, manufacturing became a liability (Skinner, 1969). As Filippini and Raffo (1990) point out, this approach was adequate in the supply-driven economic climates of the industrialised countries after World War II, when customers were not too discerning. Whilst the financiers and marketing men concentrated on sorting out corporate strategy, the task of the manufacturing function was simply to meet the required quantities and schedules, with a minimum of cost variance (Filippini and Raffo, 1990).

Skinner (1969) identified the absence of manufacturing in the corporate strategic planning process. The need of a manufacturing strategy was established because manufacturing strategy can be used to exploit certain properties of the manufacturing function to achieve competitive advantage. Without a meaningful strategy, firms often make short-term decisions that are in conflict with their long-term goals, which invariably results in a poor match between manufacturing activities and the firm's overall strategy (Menda and Dilts, 1997). This problem is further emphasized by the fact that although, ordinarily, most firms within an industry share access to the same processing technology, manufacturing systems, and infrastructure elements, they are not equally successful in linking those aspects to the criteria critical to wining orders (Hill, 1989).

Mills and Platts (2001) indicate that it is usual for the manufacturing function of a manufacturing company to: control 90 per cent of the firm's installed capital; be responsible for 70 per cent of revenue expenditure; hold 80 per cent of the firm's net assets; and employ over 50 per cent of the firm's workforce. Besides manufacturing has a critical influence on product quality and cost, order lead-time, delivery time and the speed of introduction of new products. To achieve competitive performance in these areas requires, among other things: sound capital investment; sensible make versus buy decisions; human resource policies that encourage employees to give their best; and manufacturing control systems that facilitate the flow of material and orders. These are examples of some of the elements of a manufacturing strategy (Mills and Platts, 2001).

There are several authors in literature that have attempted to define the term 'manufacturing strategy'. Table 3.1 summarises some of the most representative definitions of manufacturing strategy in literature.

Skinner (1969)	A set of plans and policies by which a company aims to gain advantage over its competitors
Hayes and Wheelwright (1984)	The deployment and development of manufacturing capabilities in total alignment with the firm's goals and strategies
Cohen and Lee (1985)	The development and implementation of plans which affect the firm's choice of production resources, the deployment of these resources, and the design of the infrastructure to control operation activities
Hill (1985)	A set of policies in both its process choice and infrastructure design... which are consistent with the existing way(s) that products win orders whilst being able to reflect future developments in line with changing business needs
Swamidass (1986)	The development and deployment of manufacturing capabilities in total alignment with the firm's goals and strategies
Pannesi (1990)	A coordinated set of actions and decisions that act upon the deployment of manufacturing resources to provide a competitive advantage to the firm
Platts (1990)	A pattern of decisions, both structural and infrastructural, which determine the capability of a manufacturing system and specify how it will operate in order to meet a set of manufacturing objectives which are consistent with overall business objectives
Schroeder and Lahr (1990)	A vision for the manufacturing organisation based on the business strategy. It consists of objectives, strategies and programmes which help the business gain, or maintain, a competitive advantage
Swink and Way (1995)	Decisions and plans affecting resources and policies directly related to the sourcing, production and delivery of tangible products

Table 3.1: Definitions of Manufacturing Strategy

Whether we are referring to business or manufacturing strategy, the modern strategy discipline deals with the matching of the activities of an organisation to the environment in which it operates. In this context, strategic management is that set of managerial decisions that determines the long-term performance of a company, and it includes strategy formulation and strategy implementation (Van der Merwe, 2002).

3.1.2 The Concepts of Manufacturing Strategy Process and Content

The previous section has set out the need of a manufacturing strategy. In this section the concepts of manufacturing strategy process and content are introduced in order to understand how strategic manufacturing initiatives can be formed and how they are linked to manufacturing strategy and strategic manufacturing decisions.

According to Fahey and Christensen (1986) whereas the content of a strategy focuses on the specifics of what has been decided, the process addresses how such decisions are reached. Therefore, the mechanism needed to choose the content of a strategy is a strategy design process (Baines et al, 1993). Manufacturing companies use strategy design processes to select the many changes in their organisations necessary to survive and prosper as successful competitors in the future (Gunn, 1987). Thus, the formulation of manufacturing strategy must be one of the key tasks for operations managers (Platts and Maslen, 1996).

Many authors and manufacturing strategy formulation processes exist in literature (Hayes and Wheelwright, 1984; Fine and Hax, 1985; DTI, 1988; Hill, 1989; Gunn, 1987; Miller, 1988; Platts, 1990; Womack and Jones, 1996). The literature on manufacturing strategy development can broadly be characterised by two distinctive points of view. The first is the top down version: manufacturing strategy must be developed from the top down, that is, by considering first the competitive environment of the firm, and then by aligning strategy decisions in manufacturing with that environment. One of the most closely formulated approaches in this category is that of Hill (1989), who advocates five basic steps:

1. Define corporate objectives
2. Determine market strategies to meet those objectives
3. Assess how different products win orders against competitors
4. Establish process choice
5. Provide manufacturing infrastructure support

Key issues in this approach are that manufacturing strategy should be internally and externally consistent, and that it should explicitly contribute to competitive advantage (Hayes and Wheelwright, 1984).

The second category is the bottom up version: which advocates a set of ideals and proposes specific actions for the firm to take. An example of a closely formulated approach here is that of Womack and Jones (1996). Again, five steps are needed.

1. Specify value
2. Identify value stream
3. Create continuous flow
4. Introduce customer pull
5. Seek perfection by exposing 'muda' or waste

Therefore, although the dominant view of the strategy process is top-down, authors such as Hayes (1985) cautions that functional capabilities should, in an uncertain and unstable environment, drive corporate strategy. The model presented in Figure 3.1 is an amalgam of the view represented by the writings of authors in manufacturing strategy processes (Leong et al., 1990).

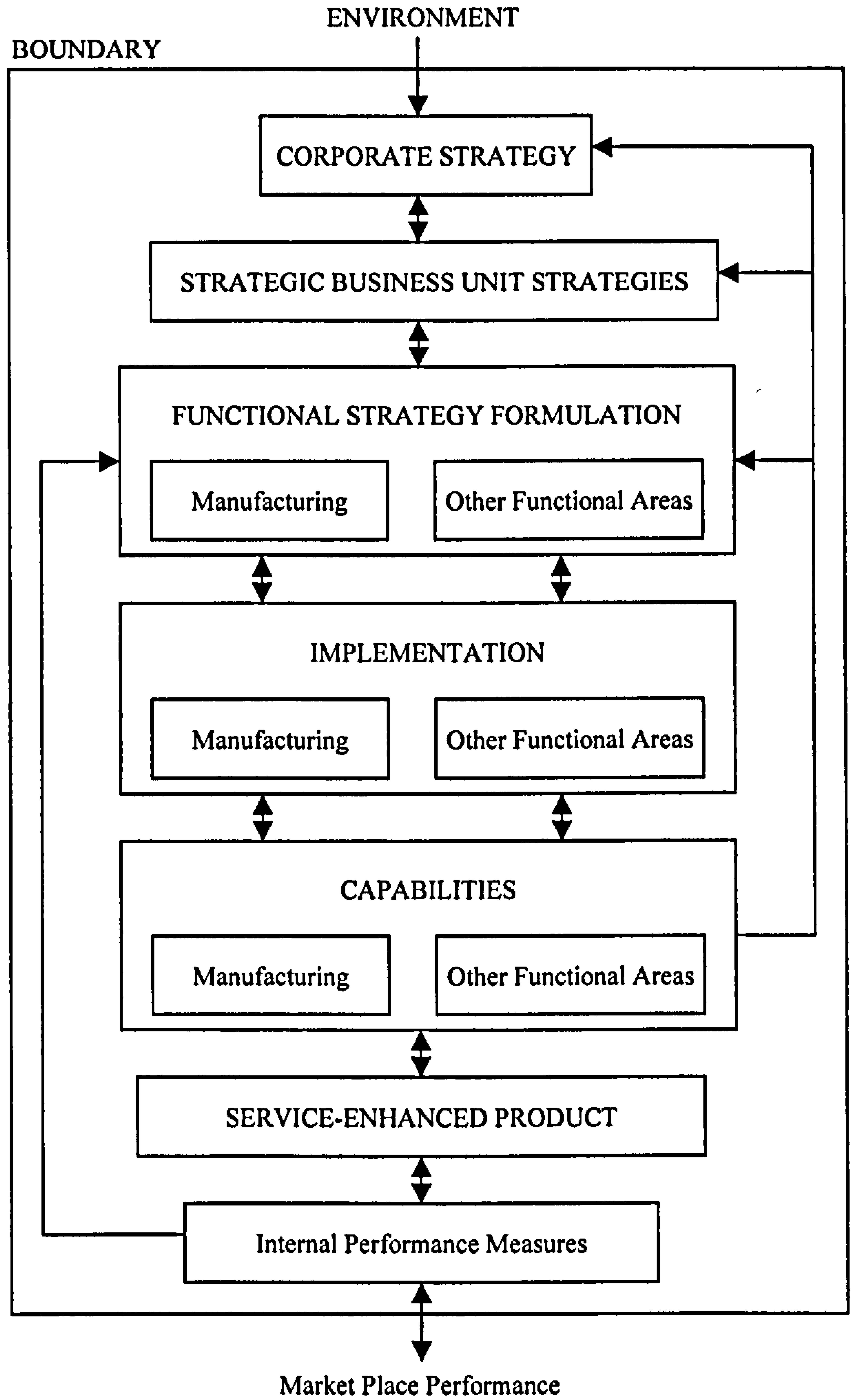

Figure 3.1: Manufacturing Strategy Process (source Leong et al., 1990)

Most writers on manufacturing strategy identify the need to define strategic priorities in terms of cost, quality, delivery and flexibility, and from these to develop broad strategic manufacturing decisions. The primary purpose of strategic manufacturing decisions is to ensure that strategic manufacturing initiatives support the chosen strategic priorities (Garvin, 1993). Although it is possible that operations capabilities can be developed from unplanned patterns of activities rather than a strategic plan (Mintzberg and Waters, 1985), operations capabilities will be a result from the strategic decisions and consequent SMIs implemented by the operation (Leong et al., 1990).

Strategic decision areas in operations are usually divided into structural and infrastructural decisions. An operation's structural strategic decisions are those which primarily influence design activities, while infrastructural strategic decisions are those which influence the workforce organisation, planning and control, and improvement activities (Slack et al, 2001). According to Slack et al (2001), structural strategic decision areas should be addressing the questions shown in Table 3.2.

New product/service development strategy:	- Should the operation be developing its own novel product or service ideas or following the lead of others? - How should the operation decide which products or services to develop and how to manage the development process?
Vertical integration strategy:	- Should the operation expand by acquiring its suppliers or its customers? - If the former, what suppliers should it acquire? - If the later, what customers should it acquire? - What balance of capabilities should it develop along its network of operations?
Facilities strategy:	- What number of geographically separate sites should the operation have? - Where should the operations facilities be located? - What activities and capacity should be allocated to each plant?
Technology strategy:	- What broad types of technology should the operation be using? - Should it be at the leading edge of technology or wait until the technology is established? - What technology should the operation be developing internally and what should it be buying in?

Table 3.2: Structural Strategic Decision Areas (source Slack et al., 2001)

According to Slack et al (2001), infrastructural strategic decision areas should be addressing the questions shown in Table 3.3.

Workforce and organisation strategy:	- What role should the people who staff the operation play in its management? - How should responsibility for the activities of the operations function be allocated between different groups in the operation? - What skills should be developed in the staff of the operation?
Capacity adjustment strategy:	- How should the operation forecast and monitor the demand for its products and services? - How should the operation adjust its activity levels in response to demand fluctuations?
Supplier development strategy:	- How should the operation choose its suppliers? - How should it develop its relationship with its suppliers? - How should it monitor its suppliers' performance?
Inventory strategy:	- How should the operation decide how much inventory to have and where it is to be located? - How should the operation control the size and composition of its inventories?
Planning and control systems strategy:	- What system should the operation use to plan its activities? - How should the operation decide the resources to be allocated to its various activities?
Improvement strategy:	- How should the operation's performance be measured? - How should the operation decide whether its performance is satisfactory? - How should the operation ensure that its performance is reflected in its improvement priorities? - Who should be involved in the improvement process? - How fast should the operation expect improvement in performance to be? - How should the improvement process be managed?
Failure prevention and recovery strategy:	- How should the operation maintain its resources so as to prevent failure? - How should the operation plan to cope with a failure if one occurs?

Table 3.3: Infrastructural Strategic Decision Areas (source Slack et al., 2001)

3.1.3 Definition of Strategic Manufacturing Initiative

Once strategic manufacturing decisions have been formulated, as presented in the previous section, the next step is the identification of strategic manufacturing initiatives. The formulation of a manufacturing strategy, such as the one presented by DTI (1988), results in the identification of a list of strategic manufacturing initiatives (SMI) that if successfully implemented would provide manufacturing organisations with the capabilities required to achieve their strategic competitiveness.

Garvin (1993) argued that SMIs should not be confused with strategic manufacturing decisions. Although both affect the way manufacturing as a whole operates and address similar kinds of decisions (e.g., capacity, facilities, technology), they differ in two fundamental ways:

1. Strategic manufacturing initiatives drive improvement and are inherently dynamic. They move manufacturing in a specified direction and toward a quantifiable end. Strategic decisions, by contrast, are relatively static; they are little more than decision rules. For example, a strategic decision in the area of capacity might be to add capacity in increments that lag, rather than lead, demand. The corresponding SMI might be to increase utilisation rates to 90% in all plants by 2005 (Garvin, 1993).

2. SMIs are more targeted. They are ranked and selected from a broad array of possible initiatives, pursued until the stated ends have been achieved, and then replaced by new efforts (Garvin, 1993).

Consequently, Garvin (1993) defines a SMI as

> "*a major manufacturing effort that seeks improvement over a specified time period. It includes both quantitative goals and specific milestones; equally important, it can be applied to the entire manufacturing organisation.*"

Other authors in the business strategy field have adopted the idea of 'breakthrough projects' from the Japanese philosophy of HOSHIN, or Breakthrough Management, which is an increasingly well-recognised management technique (Grundy, 2001). Based on Grundy's (2001) definition of a business 'breakthrough project', a SMI can then be defined as:

> "*a major manufacturing effort that will have a sizeable strategic impact on either the manufacturing external competitive edge, its internal capabilities or its financial performance – or all three.*"

For strategic manufacturing initiatives, as defined above, to be realised they must at some stage be translated into an operational implementation plan that needs to be successfully and rigorously managed. Strategic manufacturing initiatives help companies to prioritise time and resources in order to gain the maximum strategic impact and consequent competitiveness of their manufacturing function and the whole organisation. A manufacturing strategy can be seen as a stream of strategic projects over time which collectively shifts or transforms the business (Grundy, 2001).

3.2 The Importance of Successful Implementation of Strategic Manufacturing Initiatives

Most strategic manufacturing initiatives form part of bigger strategic decisions which in turn form a central part of a manufacturing strategy. Manufacturing companies formulate strategies to develop their manufacturing capabilities and therefore to increase their competitiveness in the marketplace. However, strategic manufacturing initiatives may also be identified within unplanned patterns of activities with high strategic impact rather than a strategic plan (Mintzberg and Waters, 1985).

Regardless of how strategic manufacturing initiatives are identified, manufacturing capabilities may only result if the manufacturing strategy is realised (Leong et al, 1990). This means that capabilities may only be gained if the implementation of many strategic manufacturing initiatives that form the manufacturing strategy are successful. If the set of capabilities achieved after the successful implementation of SMIs is unique from the capabilities of competing businesses then the capabilities would provide a distinctive competence (Leong et al., 1990). Strategic manufacturing initiatives serve two critical roles within the manufacturing organisation (Garvin, 1993):

1. SMIs provide a mechanism for aligning the capabilities of the manufacturing function with the strategic direction taken by the company
2. SMIs drive continuous improvement

Failing in the implementation of a strategic manufacturing initiative can have disastrous implications for the future competitiveness and strategic alignment of the organisation. Therefore, strategic management should give its primary attention to managing the implementation of strategic manufacturing initiatives, whether they are deliberate or a newly discovered opportunity, within an overall strategic vision of the business (Grundy, 2001).

The main emphasis in the strategic manufacturing literature has for many years been on the formulation side of strategies (Grundy, 1998; Al-Ghamdi, 1998). The issue of implementation has received less attention, although implementation of strategic initiatives has frequently been considered to be the graveyard of strategy (Grundy, 1998). The problem is that formulating a manufacturing strategy is far from enough to achieve the desired benefits. Marucheck et al (1990) carried out an exploratory empirical study where executives representing a cross-sectional representation of leading-edge firms indicated that the real benefits of a manufacturing strategy come from implementation as opposed to the formulation side of the strategy.

Unfortunately, many companies are still facing major difficulties during the implementation of strategic decisions derived from the formulation of manufacturing strategies (Al-Ghamdi, 1998). As Grundy (1998) points out, strategic management should move from a 90:10 concern with strategy formulation relative to implementation to at least a 50:50 concern with each. Otherwise, no mater how good the strategic decisions are, companies would not benefit from them (Al-Ghamdi, 1998). This argument is reinforced by Beer et al (1990) who attribute much of the shortcomings in the strategy area to failures in the implementation process rather than in the formulation of strategy itself. Lamentably, once a strategy has been developed, its implementation appears to be seen as a matter of operational detail and tactical adjustment carried out within the boundaries of existing company's structures and procedures (Pellegrinelli and Bowman, 1994).

3.3 The Implementation of Strategic Manufacturing Initiatives

Over the last few years there has been increasing interest in the research of new methods to improve the efficiency of strategy implementation. Whereas practitioners need efficient methods of managing the successful and rigorous implementation of strategies in their business sector, a project oriented approach has been identified as a more efficient process to manage the implementation of strategic initiatives (Clarke, 1999).

The other area of research requiring further investigation is change management. In an attempt to use change management concepts as a vehicle for the implementation of strategic manufacturing initiatives, they seem to be inappropriate. Change management literature deals with changes in the culture, structure and processes that will improve the performance and competitiveness of a company. Literature is overwhelmed with different management initiatives for managing process changes in organisations (Grover et al, 1995; Zairi and Sinclair, 1995; O'Neill and Sohal, 1999). Generally the application of a change management model such as Business Process Benchmarking, Process Redesign or Business Process Reengineering would result in the identification of initiatives that, if successfully implemented, would drive a performance and competitiveness transformation in a company. The implementation of such set of strategic initiatives, independently of being part of the change management model or not, has to be successfully managed and implemented. Since a change project completely fulfils the definition of a project, change management would benefit from the project management approach (Grover et al., 1995; Narasimhan and Jayaram, 1997; Lanning et al., 1998). In this context, project management concepts and techniques have been identified as a more efficient process to manage the implementation of strategic initiatives (Clarke, 1999).

Implementation of strategy through projects is not totally new. Numerous authors have published their views on project management as a vehicle for strategy implementation. The exploratory study carried out by Marucheck et al (1990) indicates that manufacturing strategy implementation is a project-oriented task where the implementation plan is comprised by a hierarchy of projects. Authors such as Van Der Merwe (2002) have argued that strategies do not fail when they are being analysed or when the objectives are being set but during implementation and, more particularly, due to the lack of proper project management.

Lord (1993) reports findings from a study of 20 UK engineering construction businesses which demonstrate the potential of using project management to achieve diverse strategic objectives. Through a total of 60 focused interviews with project managers, directors and senior engineering staff, this research explores the use of projects in a strategic context. Project management is regarded as an essential means of turning strategic objectives into operational ventures, providing a framework for monitoring progress and a basis on which the skilful manager can control implementation without necessarily using cross-functional, hierarchical authority. Lord (1993) argues that whatever the business, a project management approach can be used to add value to the implementation of strategic initiatives.

More and more companies are beginning to understand the benefits that can be derived from using project management tools and methodologies to help drive planned change (Clarke, 1999). Many authors and case studies, for example Hauc and Kovac (2000), have demonstrated that project management ensures a high level of efficiency in the implementation of set objectives in general. Grundy (1998) and Pellegrinelli and Bowman (1994) have given interesting views on the integration of strategic business implementation and project management. Marketing literature also suggests some kind of project management approach for the implementation of strategies, "identifying and prioritising activities, deploying resources, and coordinating and directing actions" (Sashittal and Wilemon, 1996). At this level the strategic manufacturing literature is somehow lagging behind in the research and application of project management concepts and techniques in the implementation of SMIs.

3.4 Current Research Issues in the Implementation of Strategic Manufacturing Initiatives

In the previous sections a project management approach has been identified as the most efficient process for the implementation of strategic initiatives. Unfortunately, the 'traditional' or 'conventional' project management methodologies do not seem appropriate in the strategic manufacturing area. In this context, the use of an inappropriate methodology could result in overall project failure (Saarinen, 1990; Leonard-Barton, 1987; Redmill, 1990).

Most authors state that project management had its origin in 1958 with the development of the PERT methodology (Van der Merwe, 2002). This approach was based on the computational planning and control models originating in large projects, aerospace, defence and construction (Maylor, 2001). In the American Project Management Institute's 2000 publication "A Guide to the Project Management Body of Knowledge" a project is defined as:

> "*a temporary endeavour undertaken to create a unique product or service*" (PMI, 2000)

In the same reputable publication, project management is defined as:

> "*the application of knowledge, skills, tools and techniques to project activities to meet project requirements*" (PMI, 2000).

These concepts and the whole structure and content of generic project management methodologies such as PMI (2000) and APM (2000) seem adequate for projects dealing with construction and high technology activities. For project management to be effective in implementing strategy, the structure and content of the project management methodology need to be consistent with the field in which it is utilised (Maylor, 2001).

Grundy (2001) points out that the conventional project management and strategic project management contrast in many critical aspects as shown in Table 3.3. Therefore, for project management to be effective in implementing strategy, the concept of strategic project management has to be understood as the means for achieving the successful implementation of strategies in a specific environment (Pellegrinelli and Bowman, 1994; Maylor, 2001). In the business strategy environment, Grundy (2001) defines strategic project management (SPM) as:

> "*the process of managing complex projects by combining business analysis and project management techniques in order to implement the business strategy and to deliver organisational breakthroughs*"

The traditional approach to project management gives very limited treatment to many relevant issues in the context in which project managers (regardless of whether they have that title) operate today in many industries including the strategic manufacturing area (Maylor, 2001). According to Turner (1993) the present knowledge base of project management relies on large capital construction projects which represent only 10% of the projects.

Authors such as Harvey Maylor (2001) have argued that the project management knowledge-base at present is too wide and poorly structured. As a result the literature is confusing for practitioners. Maylor (2001) also argues that there is even some doubt as to whether the traditional methods are effective in many sectors.

	Conventional Project Management	**Strategic Project Management**
Link with business strategy	Vague and distant	Direct and explicit
Project definition	Usually portrayed as a 'given'	Highly flexible, creative, depending on options
Project planning	Follows on directly from project definition	Only done once a project strategy is set
Attitude to detail	Absolutely central – it is all about control	Important but only in context – try always to see the Big Picture
The importance of stakeholders	Emphasis on formal structures – project manager, team sponsor	Far-reaching stakeholder analysis; requires continual scanning
The importance of uncertainty	Coped with through critical path analysis (after activity planning)	Do uncertainty analysis first, then plan activities

Table 3.3: Conventional and Strategic Project Management (source Grundy, 2001)

Maylor (2001) argument is reinforced by White and Fortune (2002) who conducted an empirical study designed to capture the 'real world' experiences of people active in project management. Their research consisted in a survey sent to 995 Project Managers from a wide range of industries and organisations with 236 responses (23.72% response rate). Two of the main findings of their study are as follows:

1. 28% (66) of respondents did not use any project management methodology
2. 54% (128) of respondents used their own 'in house' project management methodology

White and Fortune (2002) results show that the current project management methodologies available in literature are not found useful by a large proportion of practitioners in the field in which they operate. Figure 3.2 shows the fields in which project management is used from a survey of readers of Project Manager Today magazine in 1991 (Reiss, 1995). The food and manufacturing industry appears in sixth position with only 5.80% of readers using project management concepts in manufacturing environments.

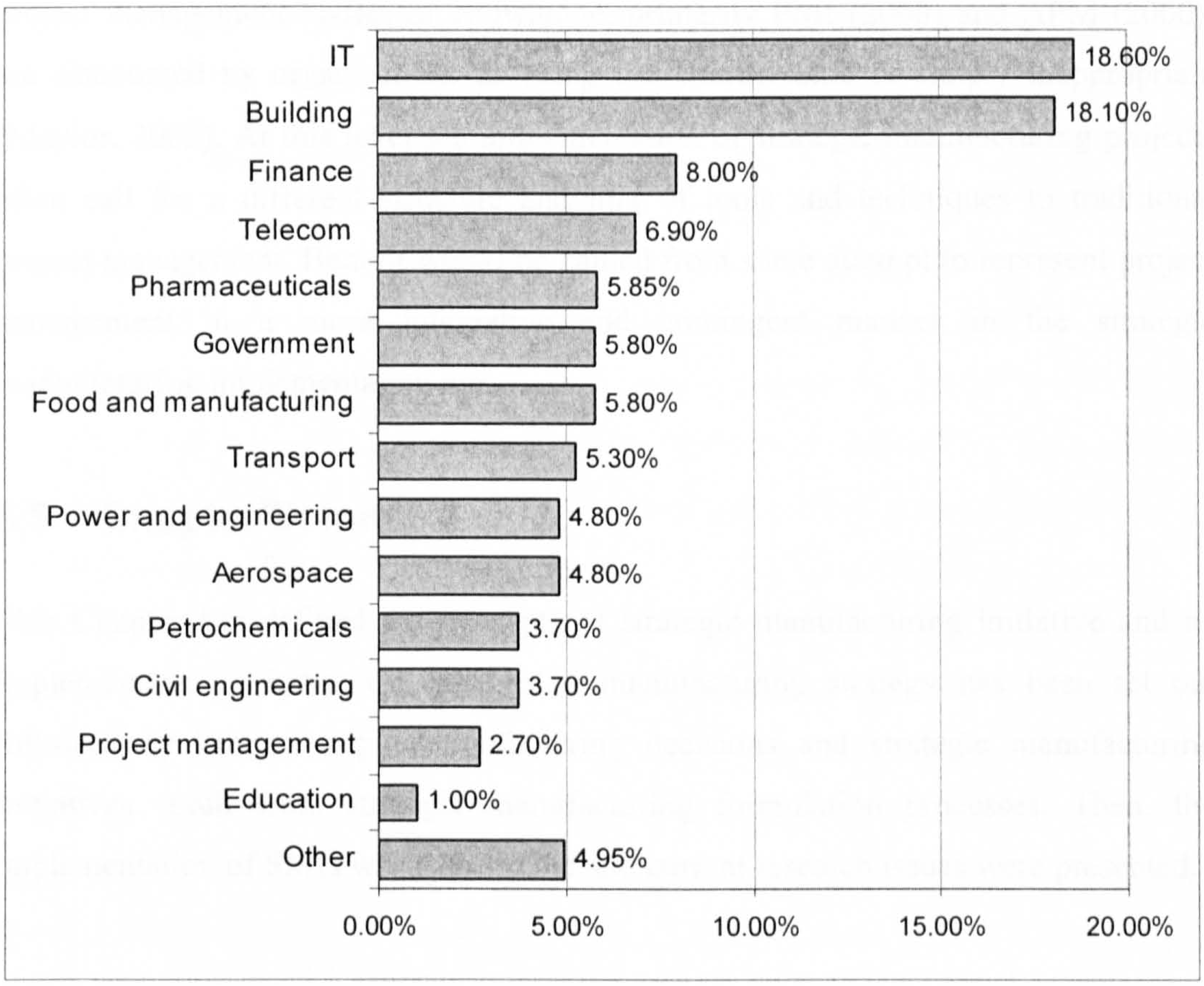

Figure 3.2: Project Management Breakdown by Industry (source Reiss, 1995)

The current literature available on project management is not sufficiently strategically relevant (Maylor, 2001). Practitioners are given cross-functional projects to manage as a reward for good functional performance. The issue of 'learning from experience' is a weakness of the current project management approach in industry and it is hardly a good basis for either individuals or organisations to be progressing from (Maylor, 2001).

With the change in the nature of project management to cover a wider range of activities comes the need to re-invent the bodies of knowledge, which are heavily influenced by the 'traditional projects' sector (Maylor, 2001). Large areas of the project management bodies of knowledge, primarily PMI (2000) and APM (2000), are discounted by organisations as being too cumbersome or simply inappropriate (Maylor, 2003). At this level the implementation of strategic manufacturing projects often call for a different structure and mix of tools and techniques to traditional project management. Benefit would be gained from some attempt to represent project management in a more integrative and contingent manner in the strategic manufacturing implementation area.

3.5 Chapter Summary

This Chapter has defined the concepts of strategic manufacturing initiative and its implementation. Firstly, the need of a manufacturing strategy has been set out followed by how strategic manufacturing decisions and strategic manufacturing initiatives result from strategic manufacturing formulation processes. Then, the implementation of SMIs was approached and current research issues were presented.

Chapter 4: Research Aim and Programme

Chapters 2 and 3 have established the area in which to direct research. There is a gap in the strategic manufacturing literature with regard to the successful and rigorous management and implementation of strategic manufacturing initiatives (SMI). Therefore practitioners cannot find an appropriate methodology that would guide them to the successful and rigorous implementation of SMIs. This chapter provides an overview of the research problem and it discusses the research aim and objectives. It also includes a description of the research programme, the research methods chosen and reasons for selection. Finally, a conclusion of the chapter is drawn.

4.1 The Research Problem

Manufacturing is a leading sector in the UK economy (Section 2.1). The manufacturing industry is critical for many other sectors in the UK economy, including many service industries, which could not exist without it. Therefore, the Trade and Industry Committee (1994) argues that the competitiveness and growth in the UK's manufacturing sector should be viewed primarily as a way of increasing the creation of national wealth (Section 2.1).

The UK manufacturing industry is in direct competition with other countries and regions. It is imperative that the design and improvement of manufacturing systems is a constant and dynamic task in the UK manufacturing environment (Section 2.1). Firms should be constantly tailoring their production systems to perform the tasks that are critical to corporate success (Section 3.1.1). Therefore, organisations must set their individual roads to new manufacturing strategies derived from the particular needs of each business (Section 3.1.2). In this context, practitioners are continually being faced with the task of implementing new strategic manufacturing initiatives that would align their manufacturing capabilities to the strategic competences required to maintain and improve the performance of the organisation (Section 3.2).

The implementation of strategic manufacturing initiatives in a typical manufacturing organisation has been seen as a project based managerial activity (Section 2.3). Unfortunately, practitioners cannot find an appropriate methodology that would guide them in the rigorous and successful implementation of SMIs (Section 3.4).

To clarify the nature of the industrial problem presented in Chapter 2, the literature was reviewed in Chapter 3 by addressing four research questions. These questions were designed to elicit: the concepts of strategic manufacturing initiative (Section 3.1) including the concepts of manufacturing strategy (Section 3.1.1), manufacturing strategy process and content (Section 3.1.2) and the definition of strategic manufacturing initiative (Section 3.1.3); the importance of successful SMI implementation (Section 3.2); how strategic manufacturing initiatives can be implemented (Section 3.3); the current research issues in the implementation of SMIs (Section 3.4).

The evidence drawn by the literature review in Chapter 3 shows that the need of a manufacturing strategy was established because manufacturing strategy can be used to exploit certain properties of the manufacturing function to achieve competitive advantage (Skinner, 1969). The formulation of a manufacturing strategy, such as the one presented by DTI (1988), results in the identification of a list of strategic manufacturing initiatives (SMI) that if successfully implemented would provide manufacturing organisations with the capabilities required to achieve their strategic competitiveness.

Strategic manufacturing capabilities may only be gained if the implementation of many strategic manufacturing initiatives that form the manufacturing strategy is successful (Section 3.2). Failing in the implementation of strategic manufacturing initiatives can have disastrous implications for the future competitiveness and strategic alignment of the organisation. Unfortunately, many companies are still facing major difficulties during the implementation of strategic decisions derived from the formulation of manufacturing strategies (Section 3.2).

A project-oriented approach has been identified as a more efficient process to manage the implementation of strategic initiatives (Section 3.3). Authors such as Maylor (2001), Turner (1993) and Grundy (2001) argue that the concepts and the whole structure and content of generic project management methodologies such as PMI (2000) and APM (2000), which are based in large construction and high technology projects, don't seem adequate for projects dealing with the implementation of strategic manufacturing initiatives (Section 3.4).

In summary, the research problem is that current project management methodologies and techniques provide inadequate support for managers facing the implementation of strategic manufacturing initiatives. There is an important need to develop a SMI implementation methodology which structure and content includes the most critical aspects in the strategic manufacturing environment. This will be a valuable aid to managers and practitioners involved with the implementation of SMIs, and most critical for the competitiveness and growth of the UK manufacturing industry and the UK economy as a whole.

4.2 Research Aim and Objectives

In the manufacturing area, the implementation of strategic manufacturing initiatives (SMI) is often undertaken by non-professional project managers. Many of these practitioners struggle to find an appropriate methodology in literature that contributes to their knowledge and capability to successfully and rigorously implement the SMIs proposed. The aim of this research therefore is

> "*to develop a methodology to guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives.*"

Realising this aim will provide practitioners with a structure to deal with the implementation of SMIs and to increase the efficiency of the process of manufacturing strategy implementation. There are a number of research issues involved in the fulfilment of the research aim. Therefore, the following research objectives have been defined, to:

1. Review existing literature on methodologies for the implementation of SMIs
2. Identify critical success factors in the practical implementation of SMIs in industry
3. Develop a method for SMI implementation
4. Evaluate and refine the methodology through practitioners' assessment and practical application in industry settings

The research aim and objectives have been set out. The next section proposes the research programme and methods available to execute the research.

4.3 Development of Research Programme and Methods

To realise the above aim and objectives, a strategic research programme was devised to direct the activities of this research in a sequence of stages. First, this section gives an overview of the research programme and the structure. Second, it describes each stage of the research programme, including the research method chosen and the rationale for each stage.

4.3.1 Overview of Research Programme

This research attempts to provide a practical aid in the activity of SMI implementation. This section gives an overview and outlines the structure of the research programme.

There are many ways in which this research could be carried out, but it will be structured according to the need and purpose of the research (Field and Morse, 1991). The research aim and objectives suggested six stages to achieve the delivery of the research programme. Stages 1 to 3 of the programme will concentrate on the formation of the SMI implementation methodology. These stages will enable the researcher to review significant methodologies in literature related to SMI implementation, identify the critical success factors in the implementation of SMIs in practice, and form the proposed methodology. The focus of stages 4 to 6 will be on the assessment and evaluation of the methodology.

The research aim clearly requires a focus on a SMI implementation methodology that will be relevant and rigorous to a wide variety of strategic initiatives in a wide range of manufacturing organisations. The researcher recognised the need to study an ample international selection of companies to identify the critical success aspects in the implementation of a diversity of SMIs that will be the foundation in the development of the SMI implementation methodology. Industrial survey is a typical approach appropriate for this type of research, because it combines an easy and fast reach to a wide spectrum of organisations and a rigorous scientific evaluation of the results. The assessment and evaluation of the methodology need a different type of research, primarily interviews and case study because these will produce a richness of insight that cannot be gained in other ways (Rowan and Reason, 1981).

The overall research programme is graphically illustrated in Figure 4.1, which also forms the basis for the layout of this thesis. Within each stage, tactical research methods are discussed in the corresponding chapter. The research programme is briefly outlined below. The first task will be to review and analyse existing literature related to SMI implementation methods. The next task will be to identify the critical success factors in the practical implementation of SMIs in industry by reviewing existing literature related to potential key success factors in the implementation of SMIs, and from this develop a questionnaire to study practitioners. Then, a pilot methodology will be formed by contrasting key success factors against methods. Following this stage, the pilot methodology will be assessed by a selection of practitioners, and then the feedback will be used to refine it. A case study research will be carried out to test its application. Ultimately, the final refinements will be made to enable the wider deployment of the methodology.

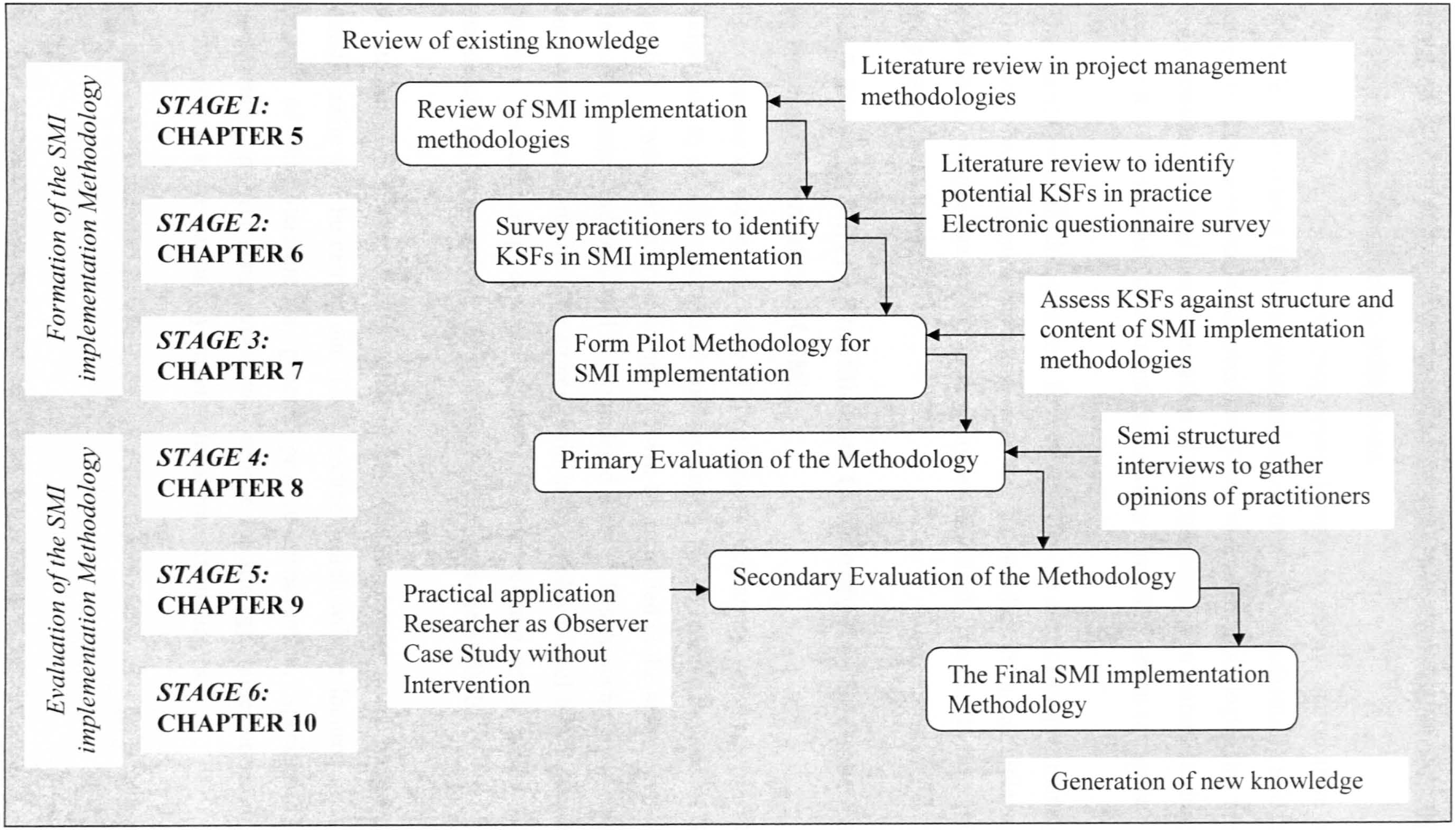

Figure 4.1: An Overview of the Research Programme

4.3.2 Stage 1: Review of Methodologies for the Implementation of Strategic Manufacturing Initiatives

The first stage of the research programme intends to review and analyse existing methodologies related to the implementation of strategic manufacturing initiatives. A review is planned to provide an overview of the various methodologies that are linked to the management and implementation of strategic projects in manufacturing, and to analyse them on the basis of a comparison system formed by seven categories.

The search for methodologies will be conducted in the area of project management. The review would act as a basis to contrast key success factors in the implementation of SMIs in practice against the methodologies identified. The results from this stage are presented in Chapter 5.

4.3.3 Stage 2: Survey Practitioners to Identify Key Success Factors in the Implementation of SMIs

The objective of the second stage of the research programme is to seek practitioners' judgement to identify the critical success factors in the implementation of SMIs in practice. A wide selection of companies will be identified in the manufacturing field. Several research methods will be considered such as Delphi techniques, interviews, and survey questionnaire. The strategy will be to employ e-mail based questionnaire surveys for collecting a large amount of data relating to a wide variety of manufacturing organisations implementing an ample range of SMIs.

A literature search to identify potential key success factors to be included in the questionnaire will be carried out. The literature search will be focused on a critical review of the literature in generic project management, specialised project management, project management as a vehicle for strategy implementation, change management, as well as on key organisational contextual factors.

It is expected that this stage should allow the researcher to investigate and identify those tasks and activities that must be done well in order to succeed in the implementation of a SMI. The results from this stage are presented in Chapter 6.

4.3.4 Stage 3: Forming the Pilot Methodology for the Implementation of Strategic Manufacturing Initiatives

This is the last stage in the formation of the SMI implementation methodology. The third stage of the research programme provides the opportunity to develop a structured and procedural method to aid the activity of SMI implementation.

To aid the discussion of possible solutions, the formation process determines the seven categories that define the new approach: philosophy, model, structure, outputs, tools and techniques, practice, and product. Based on the key success factors established in Stage 2, the most suitable aspects of the methodologies identified in Stage 1 will be mapped to generate a basis for the new approach. The contents will incorporate elements required in generic project management, and focus on the critical findings presented in Stage 2. The combined seven categories will form the pilot methodology as described in Chapter 7.

4.3.5 Stage 4: Primary Evaluation of the Methodology

This is the first part of evaluating the principles of the pilot SMI implementation methodology. The objective of the forth stage of the research programme is to seek practitioners' opinions to evaluate whether the methodology provides a workable, practical and procedural step in the activity of SMI implementation. The primary goal of this evaluation stage is set to determine whether the SMI implementation methodology could be generic.

A semi-structured interview method will be chosen as the appropriate research method to gather practitioners' opinions from different backgrounds. These semi-structured interviews formed the basis for the primary evaluation of the methodology. The results found in each semi-structured interview will be analysed. It is expected that this stage of the evaluation will result in a number of changes to the methodology to make it usable and useful for a wider audience. This stage should allow the researcher to validate the pilot methodology and refine the methodology based upon comments and observations obtained from the study. This stage of evaluation is discussed in Chapter 8.

4.3.6 Stage 5: Secondary Evaluation of the Methodology

This is the second part of evaluating the SMI implementation methodology. The objective of the fifth stage of the research programme is to observe the application of the methodology in practice in order to evaluate whether it is feasible, usable, and useful. A very useful research work will be adopted from Platts (1990), who has provided a set of measures for assessing the success of a process (methodology).

A case study method without participant intervention will be chosen as the appropriate research method to achieve relevance and rigour of the research aim. According to Platts et al. (1998), participant intervention poses the danger that the facilitator achieves success by means of process consultancy skills. Drawing upon Platts' suggestions, the researcher felt that a test phase without intervention would be the appropriate with the purpose of testing the methodology using a practitioner who was new to the workbook methodology; this way, the effect of assumed consultancy skills would be minimised. This case study formed the basis for the secondary evaluation of the methodology. Detailed information on the conduct of the case study and data collection methods are provided in Chapter 9.

At this stage, a practitioner who is an employee of the organisation will be allowed to use the methodology in order to reflect the capability of the workbook to be used independently of the author. The participating company will be the sponsoring organisation. One limitation of this selection of the participating company was the willingness of the sponsoring organisation to succeed in the use of the methodology. The researcher expects to act as an observer to the implementation project and study the development of the implementation using different research instruments namely: questionnaires, conversations and semi-structured interviews with people involved in the project.

The results found will be analysed. It is expected that this second stage of the evaluation will also result in a number of changes to the methodology to make it more feasible, usable and useful. This stage of testing is discussed in Chapter 9.

4.3.7 Stage 6: The Final Methodology for the Implementation of Strategic Manufacturing Initiatives

The intention of the last stage of the research programme is to collate all the suggested changes from the two evaluation stages, identify areas that need changing, refine and improve the methodology to make it easier to use for deployment to other interested companies. The effectiveness of the assessment, evaluation and data collection methods will be reviewed. The final methodology and its structure will be documented in Chapter 10. The outcome of the research programme will be a evaluated, tested and refined SMI implementation methodology.

4.4 Chapter Summary

This chapter has set out the research problem, and then proposed a solution to assist practitioners involved in the activity of SMI implementation. This was followed by establishing the research aim and objectives for the thesis. The chapter then considered the overall research programme adopted to deliver the research work. A six-stage research programme has been proposed that would satisfy the academic rigour and industry relevance. Stages 1 to 3 have been planned to enable the researcher to review the relevant literature and to identify the critical success factors in the practical implementation of SMIs, with the aim of forming the pilot methodology for SMI implementation. Stages 4 to 6 will further enable the researcher to evaluate the proposed methodology in the real world settings through practitioners' evaluation and application. The overall study will employ electronic questionnaire surveys, semi-structured interviews and case study methods to guide the research. In the next chapter, Stage 1 of the research programme, namely review of methodologies for the implementation of strategic manufacturing initiatives, is presented.

Chapter 5: Review of Methodologies for the Implementation of Strategic Manufacturing Initiatives

In Chapter 4 the research aim, objectives and programme have been set out. The aim of this research is to develop a methodology to guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives. This chapter deals with the first stage of realising this goal, by reviewing existing methodologies that are relevant to the implementation of SMIs. The chapter first presents the objective and method of this stage of the research in section 5.1, followed by an overview of the various methodologies for SMI implementation in section 5.2. The methodologies' comparison system is presented in section 5.3. Section 5.4 presents the analysis of the methodologies based on the comparison system defined in section 5.3. Finally the limitations and gaps from the review are summarised in section 5.4.

5.1 Stage 1 Objective and Method

The objective of this stage of the research is to review the existing methodologies relevant to the implementation of strategic manufacturing initiatives. The first step in realising this objective is to review comprehensively the existing methodologies.

In Section 3.3 the implementation of strategic manufacturing initiatives has been presented as a project based task. Many project management methodologies can be found by searching through the literature but none of them has been purposely designed for the successfully and rigorous implementation of strategic manufacturing initiatives. The project management literature can be divided into specialised project management methodologies and generic project management methodologies.

Two of the most internationally recognised project management methodologies of a specialised nature are the RIBA Plan of Work (Philips, 2000) and the SSADM methodology (BSI, 1994). The RIBA plan of work is recognised throughout the construction industry as the framework for the management of capital projects. It sets out in a logical fashion the activities of the design team normally necessary for the successful completion of a construction project. The RIBA Plan of Work is a process protocol which describes the activities from appraising the clients requirements through to post construction. The complex method SSADM (Structured Systems Analysis and Design Method) was developed on behalf of the British government by the consulting company LBMS-Learmonth & Burchett Management Systems in cooperation with CCTA (Central Computer Telecommunications Agency). In 1983, SSADM was declared as the standard to be applied for computing development projects of the British government. Since then, it has been permanently upgraded. The present valid SSADM version is Version 4 (since July 1990). The application of SSADM aims at the development of information systems on the basis of database systems. Therefore, the method concentrates on data flows, data models, and the chronological life cycles of entities.

Specialised project management methodologies are very specific to the environment in which they are intended to be applied and they posses very little relevance to the implementation of strategic manufacturing initiatives. Generic project management is therefore the area of research required to provide an overview of existing methodologies relevant to the implementation of strategic manufacturing initiatives.

This stage of the research firstly provides an overview of existing methodologies, then an analysis of methodologies based on a methodology comparison system. Finally a summary of the limitations and gaps of this review is presented. This section has set out how the first stage of the research programme is to be carried out. At the end of this part of the research, an overview of the existing methodologies for the implementation of SMIs will be established. In Chapter 7 these methodologies will be assessed against the list of Key Success Factors in practice identified in Chapter 6 in order to form the pilot methodology for the implementation of SMIs.

5.2 Overview of Methodologies

This section presents an overview of the five methodologies identified under the generic project management umbrella as presented in Table 5.1.

1	PMBOK	Project Management Body of Knowledge
2	BS6079-1:2002	British Standard Guide to Project Management
3	APM BOK	Association of Project Management Body of Knowledge
4	PRINCE2	Projects in Controlled Environments
5	RISKMAN	Risk-driven project management

Table 5.1: Generic Project Management Methodologies

5.2.1 Overview of PMBOK Methodology

The Project Management Body of Knowledge (PMI, 2000), also known as PMBOK, is a collection of processes and knowledge areas generally accepted within the project management discipline. This document is developed and published by the Project Management Institute (PMI). The PMI was founded in 1969 on the premise that there were many management practices that were common to projects in application areas as diverse as construction and pharmaceuticals. In 1981, the PMI Board of Directors approved a project to develop the procedures and concepts necessary to support the profession of project management. The results of this project were published in a Special Report in the Project Management Journal in August 1983. The report included a code of ethics, a standards baseline, and guidelines for both accreditation and certification.

The 1983 report was updated in 1987 with the intention to capture the knowledge applied to project management. It was then published as a stand-alone document titled, *The Project Management Body of Knowledge.* A second update took place in 1996 through a series of workshops and seminars, and 10,000 PMI members and twenty other professional and technical associations reviewed it. The current PMBOK publication was published in 2000 and builds on the document created in 1996. As an internationally recognised standard, PMBOK provides the fundamentals of project management, irrespective of the type of project be it construction, software, engineering, automotive etc.

5.2.2 Overview of BS6079-1:2002 Methodology

The British Standards Institute (BSI) published the first BS6079, A Guide to Project Management, in May 1996. The first amendment took place in January 2000. The latest publication is from 2002 and it is numbered as BS6079-1:2002 (BSI, 2002). BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level.

This standard aims to draw attention to the management problems encountered in different project environments and to present possible solutions to these problems. The solutions presented are not intended to be panaceas but to be treated as guidance that may need to be adapted to suit the particular circumstances of the project.

BS6079-1:2002 gives assistance on the planning and execution of projects and the application of project management techniques. It is intended to be relevant to projects in many industries and the public sector. This standard aims primarily to provide guidance for relative newcomers to project management and to act as an aide-mémoire for more experienced practitioners and those who interact with project management teams. BS6079-1:2002 is a guidance document rather than a statement of requirements for project management. It uses a definition of project taken from the international quality standard in project management, which includes the implementation and operational phases as part of the project lifecycle.

The principles and procedures outlined in this British Standard publication are intended to be relevant to all sizes of organisations, although they may not cover all aspects of every conceivable type and size of project. BS6079-1:2002 argues that the application of its principles and procedures in different industries may have unique and particular emphases and priorities.

5.2.3 Overview of APM BOK Methodology

APM BOK (APM, 2000), which stands for Association of Project Management Body of Knowledge, is the Association's source book from which all of its professional qualifications are derived. It is the UK vision of generic project management within guidelines set by the International Project Management Association and is aimed at people who have or intend to achieve professional status in project management. It identifies the behavioural characteristics generally accepted as desirable for project management professionals and lists the topics that are generic to project management.

The APM BOK is a generic guideline that identifies the behavioural characteristics, the knowledge areas and competencies that are desirable for professionals in project management. It is used as a reference for designing project management courses, for practising project managers, for organisations employing project management personnel and for search and recruitment agencies. It forms the framework within which all of the Association's qualifications are set and is thus of interest to both candidates and training organisations.

The APM BOK guide defines the forty two areas of knowledge required to manage any project in any organisation. It represents a common language which can be used by all project managers regardless of experience or background. The APM Body of Knowledge features terminology for project management, definitions and descriptions and a full set of references.

5.2.4 Overview of PRINCE2 Methodology

PRINCE, which stands for Projects in Controlled Environments, is a project management method covering the organisation, management and control of projects.

The method was first established in 1989 by CCTA (Central Computer and Telecommunications Agency). PRINCE was developed from PROPTII, a project management method created by Simpact Systems Ltd in 1975. PROPTII was adopted by CCTA in 1979 as the standard to be used for all government information system projects. PRINCE superseded PROPTII in 1989 within government projects.

CCTA continued to develop the method, and PRINCE2 was launched in 1996 in response to user requirements for improved guidance on project management on all projects, not just information systems. PRINCE2 is designed to incorporate the requirements of existing users and to enhance the method towards a generic, best practice approach for the management of all types of projects. The design and development work was undertaken by a consortium of project management specialists, under contract to the Office of Government Commerce (OGC), and over 150 public and private sector organisations were involved in a Review Panel which provided valuable input and feedback to the consortium.

PRINCE2 (OGC, 2004) is a *de facto* standard used extensively by the UK government and is widely recognised and used in the private sector, both in the UK and internationally. PRINCE2 has been adopted by the NHS as its preferred methodology and a number of governments world wide are looking at adopting it as their standard project management methodology. PRINCE2 is one of the few Government standards that has grown organically to be adopted by both private and public organisations such as the RAF, Tesco Stores, UK Police Forces, Rolls Royce, Camelot, British Medical Association, and Norwich Union.

5.2.5 Overview of RISKMAN Methodology

The RISKMAN (Risk Management) consortium was formed in late 1990 and approved in 1991 under the Eureka research programme, partly funded by the governments of partners in the consortium. Its aim was to increase the professionalism with which project risk is managed by industry within the European Community.

The RISKMAN methodology (Carter et.al., 1994), incorporates risk management within the procedures for project management itself. This realisation has caused the RISKMAN team to coin the phase 'risk-driven project management' in an attempt to move risk up to the top of the agenda. The RISKMAN project risk management methodology describes the activities required to identify and control the causes and impacts of risks and the integration of these to form a risk-driven project management process.

The RISKMAN project risk management methodology is intended to achieve six specific aims. These aims can be summarised within an overall aim of providing a sound basis for effective communication about methods used by project participants to manage risk. The six aims of the RISKMAN methodology are listed below:

1. To increase professional capability in the taking of risks in project environments
2. To promote general understanding of risk and probabilistic theory amongst management and staff at all levels
3. To provide general principles for effective risk management
4. To provide specific guidance on a framework within which project risk can be effectively managed
5. To clarify terminology which may form a sound basis for effective communication about risk
6. To examine, clarify, assess and provide guidance on the methods and techniques available for risk analysis and management

RISKMAN presents risk analysis techniques integrated into the different activities of project management. Project management activities designed for planning and controlling a project are also considered in terms of useful in identifying and organising project risks.

5.3 Methodology Analysis and Comparison System

The methodology analysis and comparison system used in this research is based on the work by Avison and Fitzgerald (1995) who developed a framework for comparing different information systems development methodologies. Tudor and Tudor (1995) framework builds on the seven elements of Avison and Fitzgerald (1995) framework together with the business lifecycle and the individual system' s lifecycle. Tudor and Tudor (1995) framework mainly determines the extent of lifecycle covered by the methodologies, how highly structured the methodologies are and what kind of system they are directed towards. Avison and Fitgerald (1995) framework has been adapted in defining the elements for analysis and comparison of project management methodologies. The framework has seven components: philosophy, model, structure, outputs, tools and techniques, practice, and product. Table 5.2 presents these components and their definition.

Philosophy	The principle or set of principles that underlie the methodology. These principles can be defined by the general objective of the methodology.
Model	The kinds of abstraction used in the methodology. The model can be defined in terms of the area where the methodology is specifically designed to be applicable and the physical shape of the system.
Structure	Stages covered by the methodology. It also includes the arrangement of these stages and their level of iteration.
Outputs	The deliverables of the methodology at every stage and in particular the nature of the final deliverable.
Tools and techniques	The set of hard and soft techniques included for the application of the methodology.
Practice	The user base and therefore the participants, and the skill levels and experience required to use the methodology.
Product	What the methodology includes in terms of documentation, software, training, support, consultancy and the medium used to present and disseminate the methodology.

Table 5.2: Methodology Analysis and Comparison Categories

An analysis of the methodologies found in literature is presented in the following section based on the seven methodology analysis and comparison categories identified. This methodology comparison system is used in Chapter 7 to assess the methodologies against the Key Success Factors in practice identified in Chapter 6.

5.4 Analysis of the Methodologies

This section presents a detailed analysis of the five methodologies identified for SMI implementation under the project management umbrella. The analysis is divided into the seven methodologies' comparison categories identified in Section 5.3. The analysis is presented in Tables 5.3 – 5.9.

The *philosophy* category refers to the principle or set of principles that underlie the methodology. These principles can be defined by the general objective of the methodology. In terms of similarities, the five methodologies are designed to provide a framework covering the wide variety of disciplines and activities required within a project. All the methodologies intend to provide guidance on the planning and execution of projects and the application of project management techniques. They are all aimed to a broad type of projects in many industries. The RISKMAN methodology is the most distinctive of them, dealing with risk-driven project management principles. The philosophy analysis of methodologies is presented in Table 5.3.

The *model* category refers to the kinds of abstraction used in the methodology. The model can be defined in terms of the area where the methodology is specifically designed to be applicable and the physical shape of the system. All the methodologies are generic project management methodologies intended to be useful for most projects. The methodologies are not structured in a step-by-step fashion but in sections covering specific areas, concepts and principles of the project management discipline. The model analysis of methodologies is presented in Table 5.4.

The *structure* category refers to the stages covered by the methodology. It also includes the arrangement of these stages. In terms of similarities, all the methodologies start with a number of sections incorporating an introduction, background to the methodology, purpose of the methodology, terms and definitions, and an overview of the structure of the publication. Most of the methodologies also include a project life cycle or proposed sequential arrangement of activities in project management. Then, the different areas of knowledge in the project management discipline are presented in different arrangements in each publication. The structure analysis is presented in Table 5.5. The general observation is that there are five similar stages in every methodology referring to the sequential arrangement of activities. These stages can be categorised into the following five phases:

1. Initiation –Understanding the purpose of the project
2. Planning – Defining activities, schedules, time, cost and resources
3. Execution – Carrying out project plan and relevant communication
4. Monitoring – Evaluating variances from the plans
5. Closure – Documenting and evaluating the project

The *outputs* category refers to the deliverables of the methodology at every stage and in particular the nature of the final deliverable. Each methodology is formed by a different sequence of sections that deliver a diverse list of outputs. The most comprehensive methodology is the PMBOK, which includes all the outputs referred by the other four methodologies. The final deliverable of all the methodologies would be a project file including the outputs from each section of the methodologies. The outputs analysis of each section of the methodologies is presented in Table 5.6.

The *tools and techniques* category refers to the set of hard and soft techniques included for the application of the methodology. Again the most comprehensive of the methodologies is the PMBOK, which includes all the tools and techniques addressed by the other four methodologies. The most referred tools and techniques are: Work Breakdown Structure (WBS), Risk identification and quantification techniques, Scheduling, Change control techniques, Documentation techniques, Benefit/cost analysis, and diagramming techniques. The tools and techniques analysis of methodologies is presented in Table 5.7.

The *practice* category refers to the user base and therefore the participants, and the skill levels and experience required to use the methodology. The methodologies analysed are intended for wide range of individuals involved in the project management field such as general managers, project managers, project support staff, educators and trainers. The skills required to use 4 out of the 5 methodologies analysis are relatively high mostly due to the extensive width and depth of the publications. The APM BOK is the only methodology that has been identified as suitable for individuals with low to medium project management skills or knowledge as it is a straightforward description of project management processes that references other publications for further details. The practice analysis of methodologies is presented in Table 5.8.

The *product* category refers to what the methodology includes in terms of documentation, software, training, support, consultancy and the medium used to present and disseminate the methodology. All the methodologies analysed are paper-based and they are supported by a professional organisation. Most of them benefit from internal or external providers offering training, consultancy, seminars, and professional certifications. The product analysis of methodologies is presented in Table 5.9.

PHILOSOPHY

PMBOK	BS 6079-1:2002	APM BOK	PRINCE2	RISKMAN
This publication is intended to be a basic reference for the project management profession. It describes generally accepted knowledge and practices in project management. Generally accepted means that the knowledge and practices described are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness. Generally accepted does not mean that the knowledge and practices described are or should be applied uniformly on all projects. This document is also used by the Project Management Institute as a basic reference about project management knowledge and practices for its professional development programs including: - Certification of Project Management Professionals (PMP) - Accreditation of educational programs in project management.	This British Standard takes the form of guidance and recommendations for project management. It should not be quoted as if it were a specification. This standard aims to draw attention to the management problems encountered in different project environments and to present possible solutions to these problems. This standard gives guidance on the planning and execution of projects and the application of project management techniques. It is aimed to a broad type of projects in many industries.	This publication is intended as a practical document, defining the broad range of knowledge that the discipline of project management encompasses. The contents of this document come from an independent survey of the practice of project management in relation to the elements of knowledge that project management professionals in a range of industries felt they needed. The APM, together with many other organisations, uses its Body of Knowledge as the basis for its various professional development programmes.	This methodology is designed to provide a framework covering the wide variety of disciplines and activities required within a project. The focus throughout PRINCE2 is on the business case, which describes the rationale and business justification for the project. The business case drives all the project management processes, from initial project set-up through to the finish of the project. PRINCE2 intends to provide a flexible and adaptable approach to suit all projects.	The RISKMAN methodology is the result of an European programme which aim was to increase the professionalism with which project risk is managed by industry within the European Community. The purpose of the RISKMAN methodology is to provide a general framework for professional project risk analysis and control incorporating risk management within the procedures for project management itself. It is not intended to be rigid, prescriptive or to constitute a standard as such but to provide methods to manage risk with the project management framework. This methodology targets all types of project, being therefore classified as a generic project management methodology. An organisation adopting RISKMAN would embed its risk management principles into project management procedures and applying it across the board.

Table 5.3: Philosophy Analysis of Methodologies

MODEL

PMBOK	BS 6079-1:2002	APM BOK	PRINCE2	RISKMAN
This is a Generic project management methodology intended to be useful for most projects where project teams are responsible for determining what practices are appropriate for any given project. The PMBOK guide book is divided in four sections. The first section of this publication provides an overview of the project management framework, project management context and project management processes. The second section presents the nine project management knowledge areas: 1 Project Integration Management 2 Project Scope Management 3 Project Time Management 4 Project Cost Management 5 Project Quality Management 6 Project Human Resources Management 7 Project Communications Management 8 Project Risk Management 9 Project Procurement Management The third section is dedicated to appendices such as Notes, and Additional Sources of Information on Project Management. The forth and last section of this book provides a Glossary and Index.	This is a Generic project management methodology intended to be useful for most projects. There are seven major sections to this publication: 1 Scope 2 Normative references 3 Terms and definitions 4 The corporate aspects of project management 5 Project and company organisational structures 6 The project management process 7 Project life cycle	This is a Generic project management methodology intended to be useful for most projects. The topics are described at a high level of generality; the intent is that each topic is potentially applicable in all project management situations. The APMBOK starts with an Introduction followed by seven sections: 1 General 2 Strategic 3 Control 4 Technical 5 Commercial 6 Organisational 7 People	This is a Generic project management methodology intended to be useful for most projects. There are five major parts to this manual: 1 Introduction 2 Processes 3 Components 4 Techniques 5 Appendices	This Risk-driven project management methodology is intended to be useful for most projects. There are eight major parts to this manual: 1 Background to RISKMAN 2 Introduction to Project Risk Management 3 The RISKMAN approach 4 Operating the Risk Management Process 5 Risk-Driven Project Management Process 6 Implementing RISKMAN within your company 7 Benefits and Conclusions 8 Appendices

Table 5.4: Model Analysis of Methodologies

STRUCTURE

PMBOK	BS 6079-1:2002	APM BOK	PRINCE2	RISKMAN
1 Introduction 2 The PM Context 3 PM Processes 4 Initiating Processes (Initiation) 5 Planning Processes (Scope, activities, schedule, project plan, risk, cost) 6 Facilitating Processes (Quality, staff, communications, risk, procurement, solicitation) 7 Executing Processes (Project plan execution, quality, team work, information, solicitation, contracts) 8 Controlling Processes (Change control, scope/schedule/cost/quality/risk control) 9 Closing Processes (Contract closeout, administrative closure)	1 Scope 2 Normative references 3 Terms and definitions 4 The corporate aspects of project management 5 Project and company organisational structures 6 The project management process (6.1 General; 6.2 Introduction; 6.3 Planning; 6.4 Control; 6.5 Project Management Plan; 6.6 Processes supporting the project management process) 7 Project life cycle (7.1 General; 7.2 Types of project; 7.3 Project phasing; 7.4 Project phase sequence; 7.5 Description of phase content)	1 Introduction 2 General 3 Strategic 4 Control 5 Technical 6 Commercial 7 Organisational 8 People	1 Introduction 2 Introduction to PRINCE2 3 Introduction to processes 4 Processes (4.1 Starting Up a Project; 4.2 Initiating a Project; 4.3 Directing a Project; 4.4 Controlling a Stage; 4.5 Managing Product Delivery; 4.6 Managing Stage Boundaries; 4.7 Closing a Project; 4.8 Planning) 5 Components (5.1 Business Case; 5.2 Organisation; 5.3 Plans; 5.4 Controls; 5.5 Management of risk; 5.6 Quality in a project environment; 5.7 Configuration Management; 5.8 Change Control) 6 Techniques (6.1 Product-based planning; 6.2 Change control approach; 6.3 Quality review technique)	1 Background to RISKMAN 2 Introduction to Project Risk Management 3 The RISKMAN approach (Analyse; Estimate; Organise; Follow-Up) 4 Operating the Risk Management process 5 Risk-Driven Project Management Process 6 Implementing RISKMAN within your company

Table 5.5: Structure Analysis of Methodologies

OUTPUTS

PMBOK	BS 6079-1:2002	APM BOK	PRINCE2	RISKMAN
4 Initiating Processes [Project charter, Project manager identified / assigned, Constraints, Assumptions] 5 Planning Processes [Scope statement, Scope management plan, Work breakdown structure, Activity list, Project network diagrams, Activity duration estimates, Project schedule, Risk management plan, Resource requirements, Cost management plan, Project plan] 6 Facilitating Processes [Quality management plan, Role and responsibility assignments, Communications management plan, List of prioritised risks, Probabilistic analysis of the project, Risk response plan, Contractual agreements, Contingency, Procurement management plan, Statement(s) of work, Procurement documents] 7 Executing Processes [Work results, Change requests, Input to performance appraisals, Project records, Project reports, Project presentations, Proposals, Contract, Correspondence, Payment requests] 8 Controlling Processes [Project plan updates, Corrective action, Lessons learned, Formal acceptance, Scope changes, Schedule updates, Revised cost estimates, Acceptance decisions, Performance reports, Change requests, Risk database] 9 Closing Processes [Contract file, Formal acceptance and closure, Project archives, Project closure, Lessons learned]	6 The project management process 6.1 General [Project sequence and stages, project documentation required, overview of tools and techniques] 6.2 Introduction [Overview of management processes] 6.3 Planning [Project sponsor authorisation, Project organisation, WBS, Analysis of project tasks, Ownership of tasks, Statement of Work, Time/Cost/Risk analysis] 6.4 Control [Control system, budget management, Progress monitor, Change control, Risk management, 6.5 Project Management Plan [PMP Sections, Overview of PMP Contents] 6.6 Processes supporting the project management process [Quality System, Configuration Management System, Procurement Process, Financial Control, Earned Value Management, Personnel Development]	1 Introduction [Scope and Overview of the Methodology] 2 General [Project Management Process, Programme management, Project context analysis] 3 Strategic [Project success criteria, strategy/project management plan, value/risk/quality management, health & safety considerations] 4 Control [Work content, scope management, time scheduling/phasing, resource management, cost management, change control, earned value management, information management] 5 Technical [Requirements, Configuration, Modelling and testing] 6 Commercial [Business case, financial management] 7 Organisational [Life cycle, evaluations, roles] 8 People [Communication system, personnel management]	4.1 Starting Up a Project [Project management team, Project's objectives, Business Case, Pre-plan and project approach, Risk log] 4.2 Initiating a Project [Project initiation document] 4.3 Directing a Project [Authorisation for initiation of the project, Authorisation for a stage or exception plan, Management direction and control throughout the project's life, Confirmation of project closure] 4.4 Controlling a Stage [Work Packages, Highlight Reports, Project Issues, Updated Risk log, Stage plan] 4.5 Managing Product Delivery [Team plans, Quality log updates, Project issues, Risk log updates, Checkpoint Reports] 4.6 Managing Stage Boundaries [Updated Stage Plan, Updated project plan, Updated business case, Updated risk log, Stage end report, Exception plan] 4.7 Closing a Project [Review of Project initiation document, Follow-on actions, Post-project review, End project report, Lessons learned log] 4.8 Planning [Plans, Product Checklist, Risk log updated]	3 The RISKMAN approach Analyse: [Risks documentation, Work Breakdown Structure, Constraints, Technical documentation, Specifications]; Estimate: [Quantified risks, Updated constraints and WBS, Estimated effort and time]; Organise: [Project planning, Project risk budget and planning, Mitigated risks, Reporting definition]; Follow-Up [Evolutions/modifications request, Progress reports, Decisions or actions]

Table 5.6: Outputs Analysis of Methodologies

TOOLS & TECHNIQUES

PMBOK	BS 6079-1:2002	APM BOK	PRINCE2	RISKMAN
4 Initiating Processes [Project selection methods, Expert judgement] 5 Planning Processes [Benefit/cost analysis, Work breakdown structure, Precedence diagramming method (PDM), Arrow diagramming method (ADM), Network templates, Analogous estimating, Quantitatively based durations, Mathematical analysis, Duration compression, Simulation, Resource levelling heuristics, Project management software, Cost budgeting tools and techniques, Project management information system (PMIS), Earned value management (EVM)] 6 Facilitating Processes [Benchmarking, Flowcharting, Organisational theory, Stakeholder analysis, Negotiations, Information-gathering techniques, Assumptions analysis, Diagramming techniques, Probability/impact risk rating matrix, Data precision ranking, Interviewing, Sensitivity analysis, Decision tree analysis, Make-or-buy analysis] 7 Executing Processes [Work authorisation system, Quality planning tools and techniques, Reward and recognition systems, Training, Information retrieval systems, Bidder conferences, Advertising, Contract negotiation, Weighting system, Screening system, Contract change control system, Payment system] 8 Controlling Processes [Change control system, Performance measurement, Project management software, Variance analysis, Pareto diagrams, Statistical sampling, Flowcharting, Trend analysis, Information distribution tools and techniques, Project risk response audits] 9 Closing Processes [Performance reporting tools]	6 The project management process 6.1 General [Project sequence diagram] 6.2 Introduction [None] 6.3 Planning [Process flow diagram, WBS, SOW, Milestones, Histograms, Activity on Arrow/Node] 6.4 Control [Change control, Risk management, Motivational techniques, Negotiation techniques] 6.5 Project Management Plan [PMP Checklists, 6.6 Processes supporting the project management process [Quality Plan, Risk management process, Procurement processes, Cost pattern diagram, Cash flow statements, Earned Value Management and Charts, Personnel development techniques]	1 Introduction [None] 2 General [Project Management Chart] 3 Strategic [Key Performance Indicators, PMP, Project Execution Plan, Risk management techniques] 4 Control [Product/Work/ Organisational/Cost Breakdown Structures, Gantt Charts, Critical Path Analysis, Precedence techniques] 5 Technical [Modelling and Testing techniques, Value Engineering] 6 Commercial [Business Case, Key Investment Gates, Cash flow] 7 Organisational [Life cycle, Project Evaluation] 8 People [Communication system, teamwork, conflict management]	4.1 Starting Up a Project [Plans, Management of Risk, Organisation, Business Case] 4.2 Initiating a Project [Plans, Quality, Management of Risk, Business Case] 4.3 Directing a Project [Controls] 4.4 Controlling a Stage [Change control, Configuration Management, Quality review] 4.5 Managing Product Delivery [Change control, Plans, Quality review] 4.6 Managing Stage Boundaries [Plans, Business Case, Management of Risk, Controls, Organisation] 4.7 Closing a Project [Configuration management, Business case] 4.8 Planning [Product-based planning]	3 The RISKMAN approach Analyse: [Needs analysis, Activity analysis, Product Breakdown Structure, Work Breakdown Structure, Functional Breakdown Structure, Risk identification techniques, Reliability & security techniques, Value analysis, Constraints analysis]; Estimate: [Risk quantification techniques, Estimation models, Statistical techniques, Financial techniques]; Organise: [Risk data analysis techniques, Risk mitigation techniques, Scheduling, Organisation Breakdown Structure]; Follow-Up: [Progress control, Monitoring indicators, Evolution and change control]

Table 5.7: Tools & Techniques Analysis of Methodologies

PRACTICE

PMBOK	BS 6079-1:2002	APM BOK	PRINCE2	RISKMAN
Users and Participants Senior Executives, Managers of project Managers, Project Managers and other project team members, Project customers and other project stakeholders, Functional Managers with employees assigned to project teams, Educators teaching project management and related subjects, Consultants and other specialists in project management and related fields, Trainers developing project management educational programs Skill levels required Relatively high due to the depth of the document detailing all the aspects of the project management knowledge areas and targeting a very wide audience	Users and Participants General managers, Project managers, Project support staff, Educators and trainers Skill levels required Relatively high due to the width and depth of the document. Its structure is difficult to follow and there are may cross-references that make the use of the methodology even more complicated.	Users and Participants Newcomers to the Project Management field and those who want to become project management professionals through the Association's certificate. Skill levels required Low to medium skills required. It is a straightforward description of project management processes that references other publications for further details.	Users and Participants Senior Managers, Project Managers, Project Auditors, Quality assurance personnel, Members of the Project Team, Line Managers of Project personnel Skill levels required Relatively high due to the size of the document reaching 400 pages of detailed processes, components, techniques and appendices targeting a wide audience and general project management contexts	Users and Participants High management, Functional managers, Project managers Skill levels required High because the structure of the publication is difficult to follow. It is a collection of concepts and not a step by step a methodology or framework. It is difficult to integrate the RISKMAN models and techniques into a step-by-step framework for project management in practice.

Table 5.8: Practice Analysis of Methodologies

PRODUCT

PMBOK	BS 6079-1:2002	APM BOK	PRINCE2	RISKMAN
Paper-based methodology supported by the Project Management Institute. PMI members also receive educational seminars and high-quality periodicals. PMBOK is the basis of the PMI Project Management Professional certification.	Paper-based methodology supported by the British Standard Institute.	Paper-based methodology supported by the Association of Project Management. There are many training organisations offering services for APM BOK. It forms the framework within which all of the Association's qualifications are set and is thus of interest to both candidates and training organisations.	Paper-based methodology supported by the Office of Government Commerce (OGC). There are many service providers offering training, consultancy, tools and services for PRINCE2, thus ensuring a competitive supply of services available to support organisations in their implementation and use of the method. In addition, there is an active user group dedicated to the support, promotion and strengthening of the method. PRINCE2 is the basis of a professional qualification.	Paper-based methodology supported by the EUREKA programme formed by an European consortium aiming to incorporate best European practice in risk-driven project management. RISKMAN concepts are included in the contents of many project management and risk management training programmes. RISKMAN is designed to be compatible with project management standards such as PRINCE.

Table 5.9: Product Analysis of Methodologies

5.5 Gaps in existing Methodologies

In section 5.4, the project management methodologies related to the implementation of SMIs were analysed based on their particular philosophy, model, structure, outputs, tools and techniques, practice, and product. The purpose of this section is to highlight the initial gaps identified during the review of the methodologies.

In terms of the set of principles that underlie the methodologies, they have failed to address the strategic factors specific to the implementation of strategies in manufacturing operations. They tend to focus more on defining the broad range of knowledge that the discipline of project management encompasses. Failure to identify the strategic nature of SMI projects may impact upon the overall success.

The analysis shows that current methodologies intend to cover most projects where project teams are responsible for determining what practices are appropriate for any given project; however, there is room for improvement to provide practical use of project management principles, processes and techniques in the strategic manufacturing implementation area. It is observed that, whilst most methodologies follow a similar approach to project management, many of them fail to clearly identify a step-by-step sequence of stages and activities to rigorously implement a project. Project management processes are mostly presented at a high level of generality, and hence provide little guidance with respect to application of stages and activities; the intent seems to be that each topic is potentially applicable in all project management situations.

5.6 Chapter Summary

This Chapter has analysed five renowned project management methodologies relevant to the implementation of strategic manufacturing initiatives. It has discussed the objective and method for undertaking the analysis, and it has identified the analysis and comparison categories. An overview and an analysis of the existing methodologies for the implementation of SMIs has been established. In Chapter 7 these methodologies will be assessed against the list of Key Success Factors in practice identified in Chapter 6 in order to form the pilot methodology for the implementation of SMIs.

Chapter 6: Survey of Practitioners to Identify Key Success Factors in the Implementation of Strategic Manufacturing Initiatives

The previous chapter reviewed the existing methodologies relevant to the implementation of strategic manufacturing initiatives. The research programme presented in Chapter 4 has established the second stage of the research, namely the identification of key success factors in the implementation of strategic manufacturing initiatives in practice. The objective and method for this stage of the research are introduced first. This is followed by a description of the methodology for analysis. The results and findings from this research process are discussed. Observations from the study are highlighted, and finally conclusions drawn.

6.1 Stage 2 Objective and Method

In order to develop a methodology that would successfully guide practitioners in the implementation of SMIs, we must focus on those tasks and activities that must be done well in order to achieve success. Success is more likely by focusing attention on the important few key factors and by separating them out from the many trivial ones (Clarke, 1999). Key success factors can be thought of as the tasks or attributes that should receive priority attention because they strongly drive performance. Key success factors must be right to ensure that goals or objectives are met. Clarke and Garside (1997) argue that once these factors have been identified, the value of benchmarking project management methodologies then comes from drawing attention to those tasks that are key to the success of SMI implementation projects (Chapter 7).

The objective of this stage of the research is to identify the key success factors in the implementation of strategic manufacturing initiatives in practice in order to assess the methodologies presented in Chapter 5 against these factors. The pilot methodology for the implementation of SMIs is then formed based on this assessment (Chapter 7).

The purpose of this stage of the research is to identify the critical factors in the implementation of strategic manufacturing initiatives. The literature does not provide these critical factors. Therefore, it was necessary to seek practitioners' judgement to identify the most critical aspects that positively influence the successful implementation of strategic manufacturing initiatives. There are five parts to this stage of the research: firstly, the research method and the selection of participants; secondly, the design, content and pre-test of the research method; thirdly, the analysis of results; and finally, a discussion of the key success factors and others findings from the study.

6.1.1 Research Method

This section considers the methodology employed to seek practitioners' judgement to identify the key success factors in the implementation of SMIs in practice. Kinnear and Taylor (1996) observed that when the information needs of a study require data about respondents attitudes, perceptions, motivations, knowledge, and intended behaviour, asking people questions is essential. Therefore, a respondent based information generation research method was chosen.

The stage considered three methods: Delphi technique, interviews and survey questionnaire. The Delphi technique is a way of obtaining group input for ideas and problem solving from 'experts' in the field. The technique requires no face to face participation and essentially consists of three or more rounds to elicit information and feedback from the participants involved in the process. Whilst this approach predicts a reliable judgement and maintains anonymity of participants, it requires adequate time and participant commitment, and produces biased judgements of the selected group (Adesola, 2002).

The interview method allows the interviewer to maintain spontaneity and to clarify responses when necessary. Respondents can express themselves in their own language and the duration of the interview can be clearly determined. However disadvantages include the expense of the interviews, the constraint upon sample size due to the time require to undertake each individual interview, the large amount of administration involved, problems associated with respondent anonymity, the possibilities of causing inconvenience to respondents, and the effects of interviewer bias on respondents (Ellson, 2002).

The survey questionnaire approach is very useful for contacting a large number of people and to get their views. This method does not allow interviewer intervention to correct misunderstandings (Oppenheim, 1996) or to offer explanation and therefore, if a respondent is not clear about a question, little can be done to clarify this because no interviewer is available (Zikmund, 1997). Advantages of survey questionnaires include reliability in assuring respondent anonymity, demanding a reasonably low level of administration, possessing a high level of standardisation, reducing the effects of bias introduced by interviewers, enabling the completion of questionnaires in the respondents own time, and requiring reduced resources (Adesola, 2002).

After considering the reasons for and against each of the three information collection methods, it was decided to select and implement the survey questionnaire approach for this stage of the research. In order to gain a thorough understanding of these factors it is important to gather the experience and knowledge of many industries, from different geographic locations, in a broad range of types and sizes of SMIs (Section 6.1.2). The nature of this research meant that a questionnaire-based survey of practitioners worldwide was selected as the most appropriate research method among the research methods available, such as personal interviews or Delphi technique, for gathering the required information from a large sample size and from a wide geographic area and where there is no possibility of interviewer bias.

Electronic survey questionnaire via e-mail was chosen because many electronic surveys in literature have obtained higher response rates compared to other paper based studies. Using electronic questionnaires have other advantages compared to paper based questionnaires such as quicker analysis, because they are received in electronic format, and less chances of errors made by the researcher when retyping the responses into a computer for further analysis.

6.1.2 Selection of Participants

Once the method was determined, the next step was to sort out people and companies to contact. The factors influencing the success of SMI implementation projects could possibly vary based on the specific characteristics of a company, such as the manufacturing sector and company's location, and by the characteristics of the SMI, such as the type of SMI considered and the size of the project in terms of number of people affected in the implementation process and by its outcome. Therefore, the selection of manufacturing organisations was carried out in order to provide a substantial diversity of products, size, and geographic location.

A wide variety of manufacturing organisations are represented in the selected and responding organisations. A sample of 135 manufacturing organisations across the globe was selected. The 106 respondent organisations cut across organisational size as shown in Figure 6.1.

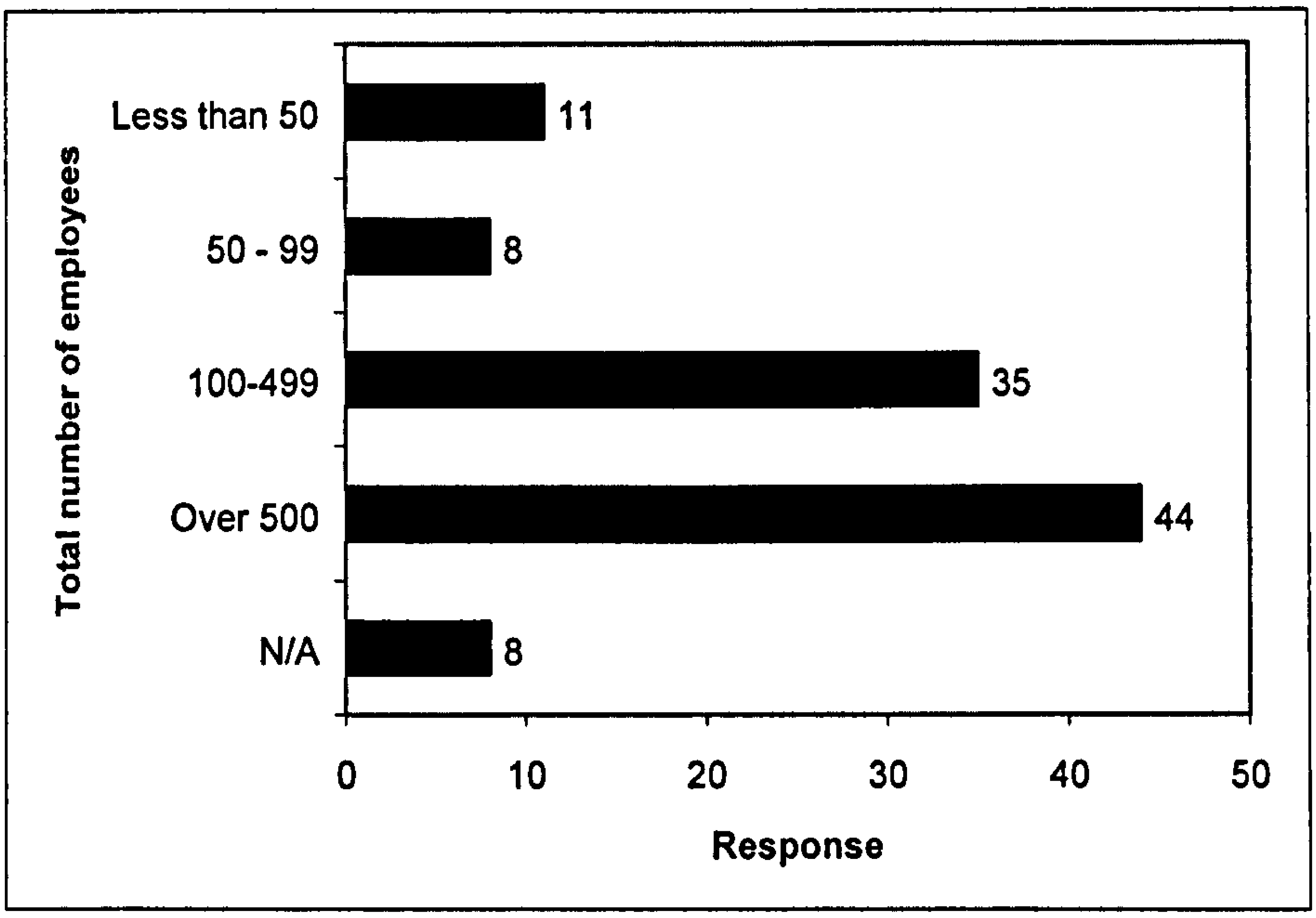

Figure 6.1: Total Number of Employees in the Respondent Organisations

The industrial activities represented by the responding organisations are diverse and include tool manufacturing, refrigeration, power supply manufacturing, electronic assembly, motor manufacturing, thermostat manufacturing, appliance control manufacturing, shelving manufacturing, air conditioning, construction materials, metal fabrication, computer assembly, compressor manufacturing, general storage products, measuring devices, computer manufacturing, hand tool manufacturing, natural gas and propane products, telecom manufacturing, treatment and manufacturing of liquids, retail supply, home appliances manufacturing, cable assembly, microwave technology products, mobile power and charging systems, and vacuum systems manufacturing.

The sample of organisations was selected from a database of high technology manufacturers of a multinational corporation. This corporation plays a small role in the individual operational activities of the companies. Besides the links and similarities among these manufacturing companies are very limited. Therefore at this stage of the design of the research we argue that the companies in our study perform their activities with a great amount of independence and the findings resulting from our survey should be universal. The director of operations, the manufacturing manager, a functional manager, an engineer or other employee within the manufacturing organisation was selected from each company.

6.2 Design, Content and Pre-test of the Research Method

This section describes the design, content and pre-test of the survey questionnaire. A questionnaire was developed to meet the needs of this stage of the research (Section 6.1): to identify the key success factors in the implementation of strategic manufacturing initiatives in practice. A development process was carried out in order to ensure that the precise nature and format of the final questionnaire was suitable for its purpose (Bradburn et al., 1979; Sheatshley, 1983).

Churchill (1998) provides step-by-step guidelines to help researchers develop a sound questionnaire device. The model proposed by Churchill (1998) is shown in Figure 6.2.

Step 1
Specify what information will be sought

↓

Step 2
Determine type of questions and method of administration

↓

Step 3
Determine content of individual questions

↓

Step 4
Determine form of response to each question

↓

Step 5
Determine wording of each question

↓

Step 6
Determine sequence of questions

↓

Step 7
Determine physical characteristics of questionnaire

↓

Step 8
Re-examine steps 1-7 and revise if necessary

↓

Step 9
Pre-test questions and revise if necessary

Figure 6.2: Questionnaire Design Process (source Churchill, 1998)

The application of Churchill's steps encourages discipline and thoroughness in the formulation of the questionnaire. This model was used as the basis for the questionnaire development in this stage of the research. The nine steps of the model were considered and they are described in Sections 6.2.1 to 6.2.9.

6.2.1 Step 1: Information Sought

The first stage of developing the questionnaire requires the determination of research categories and therefore, research boundaries within the study and a clear understanding of the information sought. This survey is conducted to identify the key success factors in the implementation of strategic manufacturing initiatives in practice. Research categories were needed to provide a basic structure and set of key issues around which the literature search and the questionnaire could be formed.

Based on the studies carried out by Mikkelsen et al (1991) in management of internal projects, Marrucheck et al (1990) in manufacturing strategy process in practice, and Al-Ghamdi (1998) in obstacles to successful implementation of strategic decisions, the three areas of research that were naturally identified are *people*, *organisation* and *systems*.

The area of *people* deals with the individuals and groups involved or affected by the strategic implementation, the area of *organisation* deals with the strategic link and company-wide related issues surrounding the SMI implementation project, and the area of *systems* deals with the project management processes used in the implementation. These areas have been divided into smaller elements for research. A survey of the literature suggests four elements of study in the *people* category:

A. Project Manager. The research question set out is: What factors related to the Project Manager (or SMI implementation Leader) are critical to succeed in the implementation of a SMI?
B. Top/Senior Management. The research question set out is: What factors related to Top/Senior Management (Project sponsors or clients) are critical to succeed in the implementation of a SMI?

C. Project Team Members. The research question set out is: What factors related to Project Team members are critical to succeed in the implementation of a SMI?

D. Manufacturing Employees (non project team members but affected by the project). The research question set out is: What factors related to the rest of Manufacturing Employees, not directly involved in the project but that are affected by it, are critical to succeed in the implementation of a SMI?

The category of *organisation* is dealt with in literature around two elements:

E. Strategic Link and Company-Wide. The research question set out is: What Strategic & Company-wide factors are critical to succeed in the implementation of a SMI?

F. Social and External Influences: The research question set out is: What Social & External factors are critical to succeed in the implementation of a SMI?

The *systems* category is formed by one element dealing with project management processes:

G. Project Management Processes. The research question set out is: What areas of project management should receive special consideration due to their criticality for the successful implementation of a SMI?

6.2.2 Step 2: Type of Questionnaire and Method of Administration

This section describes how the information sought should be collected. A structured questionnaire provided a framework for a detailed and quantifiable basis for analysis. Section 6.1.1 presented that electronic survey questionnaire via e-mail was chosen because many electronic surveys in literature have obtained higher response rates compared to other paper based studies. The use of electronic questionnaires have other advantages compared to paper based questionnaires such as quicker analysis, because they are received in electronic format, and less chances of errors made by the researcher when retyping the responses into a computer for further analysis.

6.2.3 Step 3: Individual Question Content

The literature search to identify potential key success factors was focused on a critical review of the literature in general project management, project management as a vehicle for strategy implementation, change management, as well as on key organisational context factors. A total of 176 factors were identified and included in the first pilot questionnaire from a total of more than twenty authors including El-Sabaa (2001), Marucheck et al (1990), Milis and Mercken (2002), Al-Ghamdi (1998), Clarke (1999), Hartman and Ashrafi (2002), and Umble et al (2003). The questions that form the survey are the list of potential key success factors found in literature. This list containing the final 106 factors determined after the pre-test of the questionnaire (Section 6.2.9) and the relevant literature that suggests them are shown in Appendix A.

Additionally, based on the work by White and Fortune (2002) who carried out a survey designed to capture the 'real world' experiences of people active in project management, a further seven questions were also included in the questionnaire:

Q1: What is your industry sector? (e.g. "Automotive manufacturing" rather than simply "Engineering")

Q2: What SMI implementation project have you had in mind when you were filling in this questionnaire?

Q3: How many people are affected by the implementation of your Strategic Manufacturing Initiative (SMI)?

Q4: Which of the following have been your role/s in the implementation of your SMI? (1. Project manager / 2. Senior manager or sponsor / 3. Project Team member / 4. Other Manufacturing employee)

Q5: What is the total number of employees directly involved in manufacturing on your site?

Q6: What is your job title?

Q7: Have you identified any critical factor that is not included in the questionnaire?

6.2.4 Step 4: Forms of Response

Once the questions were formulated, a suitable method for recording answers given was investigated. A formal criterion of measurement and scale was constructed to enable rules for assigning numbers to objects in such a way as to represent quantities of attributes (Nunnally, 1967).

There are a number of measurement techniques that can be applied. For the purpose of this study it was decided to adopt an approach that would allow respondents to quantitatively reflect their opinions. All the questions regarding potential key success factors were designed to have closed answers. Seven open questions with regard to the company and the project were also included (Section 6.2.3).

The responses to questions were measured on a predetermined scale. This method was chosen because such response formats can enable the use of multivariate statistical approaches used in data analysis (Labovitz, 1970; Hair et al., 1992: Ghauri et al., 1995). When scales have reasonably equal extremes and ask for attitudinal responses, the values generated can be legitimately used in multivariate data analysis to test for statistical relationships (Fienburg, 1977; Nunnally, 1967; Kerlinger, 1986).

The scale initially used in the questionnaire was based on the seven-point Likert (1932a, 1932b) scoring system. The Likert scale was used because it effectively measures the level of feeling and attitude to the question, it is relatively easy to construct and administer, and the respondents find them easy to answer due to response categories allowing an expression of the intensity of their attitude (Malhotra, 1993). Scales with fewer that five points limit the respondent's ability to discriminate because of the inability to estate detailed graduations of opinion (Boote, 1981).

As a result of the pre-test of the questionnaire (Section 6.2.9) it was decided to increase the range of the scale to 9 points. This change was accepted as it would increase the reliability and validity of the responses (Churchill and Peter, 1984).

6.2.5 Step 5: Question Wording

When structuring the questions, a number of considerations were taken into account. The questions were designed so that they were simple, unambiguous in their wording and the language used, neutral and in no way leading or implicitly seeking preferred responses (Payne, 1979; O'Brien, 1984; Schuman and Presser, 1996). As a result of the pre-test of the questionnaire (Section 6.2.9) suggestions were considered. Minor rewordings to questions to remove ambiguities were made.

6.2.6 Step 6: Sequence of Questions

The structure of the questionnaire is based on the research categories identified. An electronic questionnaire was produced, with an explanatory front page, seven sections of questions corresponding to the seven research elements with a total of 176 factors forming the first pilot questionnaire, and a set of 7 open questions.

The explanatory front page states that the questionnaire is part of an international study of project management as a vehicle of strategy implementation in manufacturing businesses. It introduces the concept of strategic manufacturing initiative by explaining: "Companies considering the strategic development of their manufacturing systems will often face the ultimate challenge of implementing the chosen Strategic Manufacturing Initiatives (SMI) in the form of world-class practices, new manufacturing or business processes, new supply contracts and systems, etc.". Finally, it provides an example intended for further understanding of the concept of SMI: "For example, a company with a complex material flow may identify the need to increase the speed of its manufacturing processes by implementing manufacturing cells; another company with a very variable volume of a high product mix and with volatile raw material prices may identify the need to improve the accuracy of its ever-changing information by implementing a new ERP package system".

6.2.7 Step 7: Physical Characteristics of the Questionnaire

E-mail based surveys, in the same fashion as mail based surveys, have to be designed and presented in a fashion that arouses the interest of the respondent if the survey is to have a reasonable response rate (Mayer and Piper, 1982). In this research, respondents were promised to receive an executive summary of the findings if they successfully filled in and returned the questionnaire.

The questionnaire concentrates on functionality, ease of use and visual appeal. Questions are laid out in a manner that facilitates ease of answering. To this end, questions are well spaced and presented in reasonably large type size, explanations for each one of the categories have been added, and the scales against each question have been designed based on a drop-down menu to enable simple, quick and error-proof scoring. An illustration of the questionnaire in its physical format is shown in Appendix B.

6.2.8 Re-examination and Revision

The seven steps outlined in the previous 7 sections were carried out. Each step was revisited and considered. A number of factors were identified as needing alteration and were duly refined. Therefore, a thorough re-examination and revision of the questionnaire was performed.

6.2.9 Questionnaire Pre-testing

Authors dealing with empirical methodologies emphasise the importance of pre-testing and refinement of survey instruments (Hunt et al., 1982; Baker, 1991; Webb, 1992). The pre-test of the survey considers two separate issues, the content and the face validity. These two dimensions were addressed.

First, content validity refers to how adequately the contents of the questionnaire reflect the body of knowledge in the subject. The questions designed in Stage 3 (Section 6.2.3) of the questionnaire design process were constructed from a review of relevant literature in general project management, project management as a vehicle for strategy implementation, change management, as well as on key organisational context factors, which resulted in the generation of an holistic set of potential key success factors in the implementation of SMIs for testing. Primarily opinions were sought from known groups (Green et al, 1988) specifically in the academic field who could contribute expert opinions and knowledge about the content validity of the questionnaire using an interview approach.

Content validity was piloted using two university instructors and then piloted again using four managers selected from a British manufacturing company. The interviews conducted were designed in an open-ended discussion to encourage that potential content validity problems would not be encountered at a later phase of the study. A few revisions were required: minor rewordings to questions to remove ambiguities, reduction of number of questions from 176 to 106 through consolidation, and slight changes to the layout of the questionnaire to improve readability. The classification of factors into seven categories was found appropriate. The classification was also found useful to improve readability and flow and understanding of the questionnaire. This classification also facilitated the analysis of data and discussion of the results (Section 6.4).

Second, face validity testing considers whether or not the scales appear to be applicable and satisfactory to the respondents (Cronbach, 1970). To conduct the face validity tests, the understanding, interpretation and comprehension of questions by subjects were evaluated. This was combined with an appraisal of respondents' willingness and ability to respond to the questionnaire.

Face validity was tested using two university instructors and then piloted again using four managers selected from a British manufacturing company. Most university instructors and industry managers expressed that a wider scale was necessary to reflect the small differences in levels of feeling and attitude to the questions. It was decided to increase the range of the scale to 9 points.

6.3 Analysis of Survey Results

This section analyses the results of the survey executed via email during June 2003. The survey questionnaire was designed to identify the critical factors in the implementation of strategic manufacturing initiatives in practice. This section outlines the respondent sample (Section 6.3.1), the methodology used for the analysis of the results (Section 6.3.2), the identification of key success factors (Section 6.3.3), and a discussion of the results and findings (Section 6.3.4).

6.3.1 Respondent Sample

The respondents were asked to evaluate the extent to which 106 selected factors were critical for the success of SMI implementation projects. The choices for the respondents against each factor range from 1 to 9 where the higher the number the higher the criticality. The wide range of possible scores, from 1 to 9, was selected in order to capture accurately the degree of criticality that each respondent give to each one of the factors which had already been identified as important in the literature search.

The response rate was 78.5% with 106 of 135 organisations returning completed questionnaires for analysis. In the questionnaire, each respondent was asked to briefly describe a strategic manufacturing initiative that had been executed by the participating company and in which they have been involved to some degree. Table 6.1 shows the main types of initiatives that were considered.

New Material Logistic programme	Customer/Supplier cost down project
Line transfer to other facility	New inventory management system
TQM programme	TPM programme
Electronic pull system	Stock reduction programme
New mechanisation	Vertical integration initiative
Product design change for manufacturability	Merge of various business segments
New manufacturing location or relocation	Enterprise-wide business system change
Outsourcing project	Downsizing manufacturing initiative
Lean manufacturing implementation	Lead time reduction to gain greater market share
New design to manufacture programme	New ERP software package implementation
New manufacturing structure	Supply chain management
Product upgrade	Customer demand management
Development of new product line	Six Sigma initiative
New manufacturing process implementation	Supplier e-business programme
Acquisition of new technology	Set up reduction
Alternate supplier	5S manufacturing programme

Table 6.1: Main Types of SMI Considered by the Respondents

The respondents were asked for the number of people that were affected by the implementation of their chosen SMI (Figure 6.3). It shows a wide range of project sizes in the responding organisations.

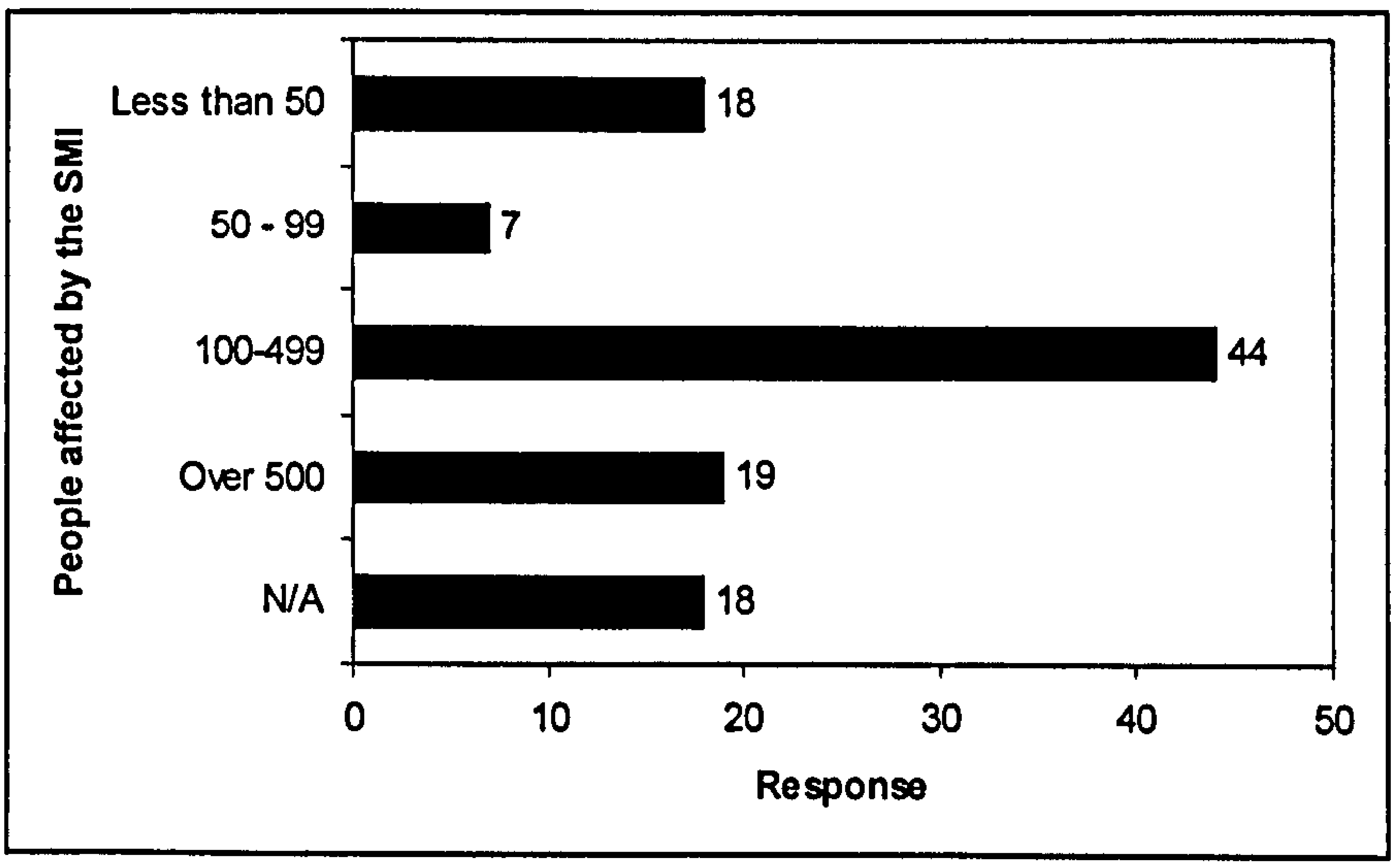

Figure 6.3: Number of People Affected by the SMIs Chosen

The wide applicability of the Key Success Factors identified through this survey is supported by two main factors:

1. The wide range of areas covered by the SMIs identified by the respondents
2. The number of people affected by the SMIs used as a measure of the different sizes of the projects.

The selection of manufacturing organisations was carried out in order to provide a substantial diversity of products, size, and geographic location. A wide variety of manufacturing organisations are represented in the selected and responding organisations. A sample of 135 manufacturing organisations across the globe were selected. The respondent organisations cut across organisational size (Figure 6.1).

The industrial activities represented by the responding organisations are diverse and include tool manufacturing, refrigeration, power supply manufacturing, electronic assembly, motor manufacturing, thermostat manufacturing, appliance control manufacturing, shelving manufacturing, air conditioning, construction materials, metal fabrication, computer assembly, compressor manufacturing, general storage products, measuring devices, computer manufacturing, hand tool manufacturing, natural gas and propane products, telecom manufacturing, treatment and manufacturing of liquids, retail supply, home appliances manufacturing, cable assembly, microwave technology products, mobile power and charging systems, and vacuum systems manufacturing.

6.3.2 Methodology for Survey Analysis

This section discusses the different options for the analysis of the survey data and it describes the methodology applied to the analysis of the data from the survey questionnaire. All the questions related to key success factors included in the questionnaire were designed to accommodate the analysis of quantitative data. A number of descriptive statistical techniques were applied to data generated in the survey. These were used to gain an insight of how each question was answered. Analysis techniques that were applied include mean, median (the number in the middle of a set of numbers; that is, half the numbers have values that are greater than the median, and half have values that are less), mode (the score which occurs with the most frequency), standard deviation (a measure of how widely values are dispersed from the mean), variance (the square of the standard deviation), range (the difference between the highest and the lowest scores), kurtosis, and skewness. The statistical analysis of the results is presented in Appendix C.

The kurtosis calculates the peak of a distribution and differentiates flat-topped frequency curves from more peaked ones. This enables a clearer understanding of the distribution of variables. The skewness (usually referred to as Pearson's measure of skewness) is used to evaluate the shape of the frequency curve of the set of values. A skewed frequency will peak to one side of the curve. Skewness characterises the degree of asymmetry of a distribution around its mean. Positive skewness indicates a distribution with an asymmetric tail extending toward more positive values. Negative skewness indicates a distribution with an asymmetric tail extending toward more negative values.

6.3.3 Identification of Key Success Factors

In order to identify the key success factors in the implementation of SMIs we must pay attention to those factors that have been identified as critical by the majority of practitioners and, therefore, they would be critical for the majority of types of strategic manufacturing initiatives and the contexts in which they are implemented. Based on the frequency distribution the categorical analysis, in a scale of 1 to 9 has been determined as a top 20% score, i.e. scores 8 or 9, against a factor is representative of its criticality as identified by the practitioner. Key success factors are therefore, those factors that have received a score of 8 or 9 by more than 50% of the 106 respondents, i.e. more than 53. Results are presented in Table 6.2. The first column, named Pos., shows the order of criticality of the key success factors. The lower the number, the higher the criticality. The second column shows the research element referred by the KSF. The third column presents the key success factors. The forth column shows the percentage and the absolute number (in brackets) of respondents scoring 8 or 9 against each factor. We have identified a total of 36 key success factors.

Pos.	Research Elements	KEY SUCCESS FACTORS	Repondents scoring 8/9
1	PROJECT MANAGER	Communication Project manager is able to listen, understand, and communicate accurately and constantly	87% (92)
2	TOP/SENIOR MANAGEMENT	Committed to project scope	81% (86)
3	PROJECT TEAM MEMBERS	Project evaluation measures are very clear to team members and included from the beginning	73% (77)
4	PROJECT MANAGER	Committed to project scope	72% (76)
5	PROJECT TEAM MEMBERS	Motivated	72% (76)
6	STRATEGIC LINK & COMPANY WIDE	Sufficient resources are at the disposal of the project manager/team	72% (76)
7	PROJECT MANAGER	Enthusiasm, positive attitude, creative thinking	71% (75)
8	SOCIAL & EXTERNAL INFLUENCES	Project creates a feeling of needed change for the better, change for the future	71% (75)
9	TOP/SENIOR MANAGEMENT	Good knowledge and understanding of business and manufacturing strategies and strategic goals	70% (74)
10	PROJECT MANAGER	Strong goal orientation	69% (73)
11	STRATEGIC LINK & COMPANY WIDE	Key implementation tasks and milestones are sufficiently defined	68% (72)
12	PROJECT MANAGEMENT PROCESSES	Project Quality Management	68% (72)
13	PROJECT MANAGER	Ability to see the project as a whole	67% (71)
14	TOP/SENIOR MANAGEMENT	Provides full, active and clearly visible support to the project during its whole life	67% (71)
15	TOP/SENIOR MANAGEMENT	Involved in strategy formulation	66% (70)
16	STRATEGIC LINK & COMPANY WIDE	There is a limited number of projects being implemented in manufacturing at any one time in order to provide focus and prioritise resources	66% (70)
17	PROJECT MANAGER	Organizing skills	65% (69)
18	STRATEGIC LINK & COMPANY WIDE	All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales)	65% (69)
19	PROJECT TEAM MEMBERS	Enthusiasm, positive attitude, creative thinking	64% (68)
20	PROJECT MANAGER	Good knowledge and understanding of business and manufacturing strategies and strategic goals	62% (66)
21	PROJECT MANAGER	Planning skills	62% (66)
22	MANUFACTURING EMPLOYEES	Awareness of the project	62% (66)
23	MANUFACTURING EMPLOYEES	Trained in how to work with the new practice/system/application/technology, the outcome and its advantages	61% (65)
24	PROJECT MANAGER	Coping with situations: Project manager is flexible, patient, and persistent	60% (64)
25	PROJECT TEAM MEMBERS	Committed to project scope	59% (63)
26	PROJECT TEAM MEMBERS	Multifunctional members from different departments	58% (62)
27	STRATEGIC LINK & COMPANY WIDE	Keep project (or project stage duration) as far below 3 years as possible (1 year is better)	58% (62)
28	PROJECT MANAGER	The same Project Manager stays during the whole duration of the strategic implementation	58% (61)
29	PROJECT TEAM MEMBERS	Changes in responsibilities are clearly defined and understood	58% (61)
30	PROJECT MANAGEMENT PROCESSES	Project Time Management	58% (61)
31	PROJECT MANAGER	Project manager is able to release the energies of his subordinates, project team members, ...	53% (56)
32	PROJECT MANAGER	Delegating Authority: Project manager is able to give people the opportunity as group members to participate in making decisions	53% (56)
33	STRATEGIC LINK & COMPANY WIDE	A sense of urgency is maintained during the life of the project	52% (55)
34	TOP/SENIOR MANAGEMENT	Enthusiasm, positive attitude, creative thinking	51% (54)
35	STRATEGIC LINK & COMPANY WIDE	The organisation engages in excellent project management including clear scope definition, resource planning, project progress tracking system, and business processes change management	51% (54)
36	PROJECT MANAGEMENT PROCESSES	Project Cost Management	51% (54)

Table 6.2: Key Success Factors

Based on median analysis, key success factors would be those with a median higher than 8. The median analysis is shown in Figure 6.4.0

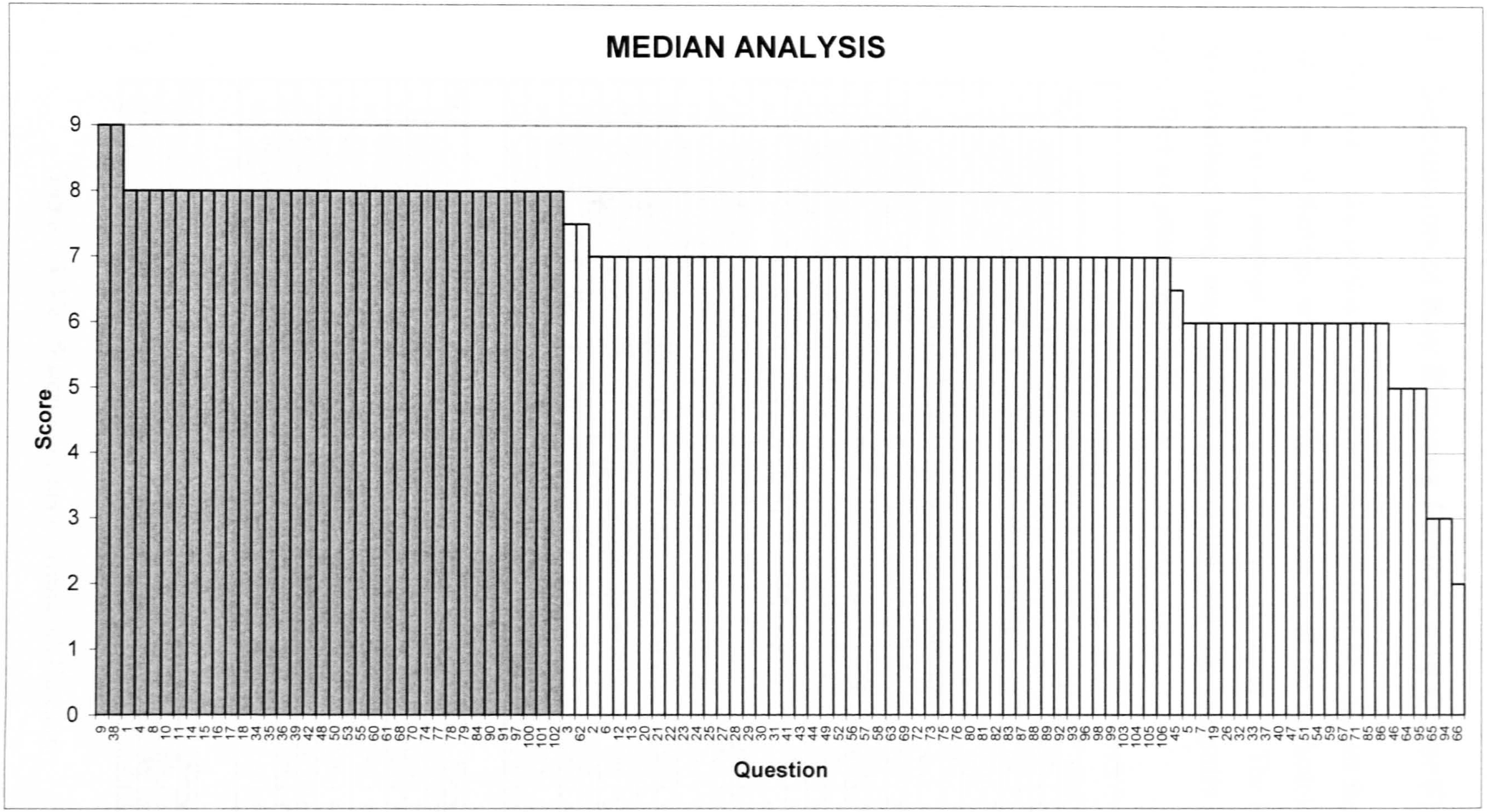

Figure 6.4: Median Analysis of Key Success Factors

6.4 Discussion of Key Success Factors and Other Findings

The objective of this section is to present a discussion of key success factors and to provide a list of findings relevant to the development of the methodology for the implementation of strategic manufacturing initiatives (Chapter 7). The key success factors identified have been grouped around the research categories for further analysis. They are presented in Table 6.3.

PEOPLE		
Pos.	Key Success Factors	Scoring
1	Project Manager is able to listen, understand, and communicate accurately and constantly	87% (92)
2	Top/Senior Management is committed to project scope	81% (86)
3	Project evaluation measures are very clear to team members and included from the beginning	73% (77)
4	Project Manager is committed to project scope	72% (76)
5	Project Team Members are highly motivated	72% (76)
7	Project Manager shows enthusiasm, positive attitude, creative thinking	71% (75)
9	Top/Senior Management has good knowledge and understanding of business and manufacturing strategies and strategic goals	70% (74)
10	Project Manager shows strong goal orientation	69% (73)
13	Project Manager has the ability to see the project as a whole	67% (71)
14	Top/Senior Management provides full, active and clearly visible support to the project during its whole life	67% (71)
15	Top/Senior Management is involved in strategy formulation	66% (70)
17	Project Manager shows organizing skills	65% (69)
19	Project Team Members show enthusiasm, positive attitude, creative thinking	64% (68)
20	Project Manager has good knowledge and understanding of business and manufacturing strategies and strategic goals	62% (66)
21	Project Manager shows planning skills	62% (66)
22	Manufacturing Employees are awared of the project	62% (66)
23	Manufacturing Employees are trained in how to work with the new practice/system/application/technology, the outcome and its advantages	61% (65)
24	Project manager is flexible, patient, persistent, and can cope well with situations	60% (64)
25	Project Team Members are committed to project scope	59% (63)
26	Project Team is formed by multifunctional members from different departments	58% (62)
28	The same Project Manager stays during the whole duration of the strategic implementation	58% (61)
29	Changes in Project Team Members' responsibilities are clearly defined and understood	58% (61)
31	Project manager is able to release the energies of his subordinates, project team members, .	53% (56)
32	Project manager delegates authority and is able to give people the opportunity as group members to participate in making decisions	53% (56)
34	Top/Senior Management shows enthusiasm, positive attitude, creative thinking	51% (54)
ORGANISATION		
Pos.	Key Success Factors	Scoring
6	Sufficient resources are at the disposal of the project manager/team	72% (76)
8	Project creates a feeling of needed change for the better, change for the future	71% (75)
11	Key implementation tasks and milestones are sufficiently defined	68% (72)
16	There is a limited number of projects being implemented in manufacturing at any one time in order to provide focus and prioritise resources	66% (70)
18	All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales)	65% (69)
27	Keep project (or project stage duration) as far below 3 years as possible (1 year is better)	58% (62)
33	A sense of urgency is maintained during the life of the project	52% (55)
35	The organisation engages in excellent project management including clear scope definition, resource planning, project progress tracking system, and business processes change management.	51% (54)
SYSTEMS		
Pos.	Key Success Factors	Scoring
12	Project Quality Management	68% (72)
30	Project Time Management	58% (61)
36	Project Cost Management	51% (54)

Table 6.3: Key Success Factors by Research Category

Four studies from the literature have been selected in order to be compared with the findings of this study (Table 6.4). These studies have been chosen for their relevance to this research. The selected literature identify the Key Success Factors in the following areas:

1. Implementation of strategic decisions (Al-Ghamdi, 1998)
2. Effectiveness of project management (Clarke, 1999)
3. Implementation of IT software projects (Hartman and Ashrafi, 2002)
4. Implementation of ERP system (Umble et al, 2003)

	Al-Ghamdi (1998)	Clarke (1999)	Hartman and Ashrafi (2002)	Umble et al (2003)
	KSFs in the implementation of strategic decisions	***KSFs to improve the effectiveness of project***	***KSFs in the implementation IT software projects***	***KSFs in the implementation of ERP***
1	Communication between all parties involved in the process of implementation	Communication throughout the project	Owner is informed of the project status and his/her approval is obtained at each stage	Clear understanding of strategic goals
2	Updated information systems in order to ensure better monitoring of the implementation activities	Clear objectives and scope	Owner is consulted at all stages of development and implementation	Commitment by top management
3	Good control system over quality and cost involve in the process	Breaking the project into 'bite sized chunks'	Proper communication channels are established at appropriate levels in the project team	Excellent project management
4		Using project plans as working documents	The project has a clearly defined mission	Organisational change management
5			Top management is willing to rovide the necessary resoures (money, expertise, equipment)	A great implementation team
6			The project achieves its estated business purpose	Data accuracy
7			A detailed project plan (including time schedules, and milestones) with a detailed budget in place	Extensive education and training
8			The appropriate technology and expertise are available	Focused performance measures
9			Project changes are managed through a formal process	Multi-site issues
10			The project is completed with minimal and mutually agreed scope changes	

Table 6.4: Key Success Factors in Selected Literature

Key findings from the study have been grouped into the three research categories identified for better interpretation of results: People, Organisation and Systems.

The people. The highest number of key success factors is found under Project Manager element of the *people* category. The results of our study demonstrate the critical importance of recruiting the right individual who possesses the necessary personal qualities to positively influence the ultimate success of the SMI implementation project. The success of SMI implementation projects is very much dependant on the Project Manager in charge of it.

The results also show that in a manufacturing environment the successful implementation of SMI projects require full, continuous and visible support from the Senior Management. We must make sure that they get behind the Project, the Project Manager and the Project Team and that everyone in the organisation is aware of that. There should be a clear and shared understanding of the project evaluation measures so that Team Members know how they are going to be evaluated. This will provide the right focus to their actions.

Based on the critical success factors identified, the project manager can more efficiently select the project team members if the opportunity is given. The personal qualities and attitude of the Project Team Members selected are key to creating the most suitable environment for the success of the project. Additionally, we must create and communicate the appropriate departmental reorganisations that will affect Project Team Members so we avoid the dangerous misunderstandings and the consequent lack of responsibility and ownership. Manufacturing Employees understanding of the SMI project, its progress and current status, and their knowledge about how to make use of the new initiative is critical for the successful implementation of the project as well as for the realisation of the benefits of the initiative and, therefore, the ultimate success of the project.

The lowest scores for criticality in this research category are given by practitioners to project management training for Project Team Members, Senior Management and Manufacturing Employees. In the Project Manager element of the questionnaire, the lowest criticality is given to the Project Manager's skills in finance and accounting, and Project Manager's experience with similar projects.

Finding 1 – Project Manager's individual qualities and skills is the most critical factor for the success of the implementation of a Strategic Manufacturing Initiative. Unexpectedly, the first and most important finding of our research is not emphasized by any of the four studies from literature presented in Table 6. This result highlights the distinctive nature of project management in the manufacturing area and, more specifically, in the implementation of strategic initiatives.

Finding 2 – The success of project management in the strategic manufacturing field is very much dependent on the human side of a project. The people category has received the highest criticality scores in our survey and, therefore, it should receive the maximum attention in the process of strategy implementation and in the design of a SMI implementation methodology.

The organisation. In the *organisation* category, the dedicated focus and full attention of the organisation on the Strategic Manufacturing Initiative implementation project are critical factors for success. These are achieved by providing sufficient resources at the disposal of the Project Manager and team, limiting the number of projects being implemented at the same time, linking all performance measures to Strategic Manufacturing objectives, and keeping project duration as short as possible.

Clarity and understanding appear to be critical factors in the form of having key implementation tasks and milestones sufficiently defined. The creation of a sense of urgency about the project seems to have important implications for the ultimate success of the SMI implementation project. Probably this sense of urgency may help to receive and gain the required resources and additional funding, when needed, and to encourage people to spend the necessary time and effort to make things happen.

Finally the manufacturing organisation must engage in excellent project management by formalising and continuously improving the processes involved in project implementation management and business change management. In the Social and External influences area, the key consideration should be given to creating a positive environment and good expectations for the future after the project has concluded will critically help the success of the implementation.

Finding 3 – Organisations facing the successful accomplishment of a Strategic Manufacturing Initiative must focus their efforts in ensuring the availability of resources and convincing employees of the criticality of the initiative.

Finding 4 –Project Management critically contributes to the success of the implementation of SMIs.

The systems. The American Project Management Institute (PMI, 2000) divides the Project Management Processes into nine categories: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management. The results of our study show that, in the *systems* category, those processes that facilitate the achievement of the requirements of the project, its completion on time and within budget, are considered most needed for the success of SMI implementation projects. The Project Management Institute (2000) defines these processes as follows: Project Quality Management are the "processes required to ensure that the project will satisfy the needs for which it was undertaken" (PMI, 2000); Project Time Management are the "processes required to ensure timely completion of the project" (PMI, 2000); Project Cost Management are the "processes required to ensure that the project is completed within the approved budget" (PMI, 2000).

Surprisingly Project Risk Management has received a very low criticality score. Risk Management processes are not identified as critical by practitioners in the manufacturing area. Contrastingly, authors such as Cooke-Davies (2002) in his empirical research from more than 70 companies on KSFs in project management, identify the adequacy of company-wide education on the concepts of risk management, the maturity of an organisation's processes for assigning ownership of risks, the adequacy with which a visible risk register is maintained, and the adequacy of an up-to-date risk management plan as some of the few most critical factors in project management success.

Finding 5 – A successful Project Management methodology for the implementation of Strategic Manufacturing Initiatives would emphasise the use of Project Quality, Cost and Time Management processes.

6.5 Chapter Summary

This chapter has presented the second stage of the research programme, namely the identification of key success factors in the implementation of strategic manufacturing initiatives. The stage objective was realised through a survey questionnaire of practitioners. First, the research method was determined, followed by the selection of participants. Secondly, the design, content and pre-test of the research method were presented. Thirdly, the analysis of survey results was described. Finally, key success factors and other findings were discussed.

The survey set out to determine the key success factors in the implementation of strategic manufacturing initiatives. A total of 36 key success factors have been identified (Section 6.4). The discussion of KSFs has presented 5 key findings. In the manufacturing environment the Project Manager of SMI implementation projects assumes a high responsibility for the overall success. Special attention should be given to the Project Manager's personal qualities and skills included in the list of key success factors, and his understanding of the strategic direction of the manufacturing function and of the organisation. SMI implementation success comes more critically from the human or people side of project management as opposed to organisation and systems related factors. Other key findings include the organisation's focus on the resources available for the project, a shared understanding of the importance of the successful achievement of the initiative, the use of project management systems and more specifically the use of quality, cost, and time management processes.

The degree of influence of the existence of a corporation that owns all the companies in our study has been considered. Based on the independence in which the companies perform their operational activities it has been concluded that the results presented should be universal. Future studies using a different sample of companies could be carried out in order to test the universality of our results. The following chapter continues the research programme by forming the pilot methodology for the implementation of strategic manufacturing initiatives by assessing the methodologies reviewed in Chapter 5 against the key success factors identified in Chapter 6.

Chapter 7: Forming the Pilot Methodology for the Implementation of Strategic Manufacturing Initiatives

The analysis of existing project management methodologies relevant to the implementation of SMIs (Chapter 5) provided an insight into the various methods reviewed and constituted stage 1 of this research. The second stage involved the identification of key success factors in the implementation of SMIs in practice (Chapter 6). This chapter deals with stage 3 of the research programme, namely the formation of the pilot SMI implementation methodology. The chapter starts with the objective and method used to form the pilot methodology. The seven categories that define the new methodology are determined in section 5.2. Finally, an overview of the pilot SMI implementation methodology is presented in section 5.3.

7.1 Stage 3 Objective and Method

The objective of the third stage of research was to develop a structured and procedural method to aid the activity of SMI implementation. The first step in achieving this objective was to analyse current methodologies relevant to the implementation of SMIs (Chapter 5), second to identify the key success factors in SMI implementation in practice (Chapter 6). Once these factors have been determined, the value of benchmarking project management methodologies then comes from drawing attention to those tasks that are key to the success of SMI implementation projects.

Current project management methodologies are said to be too wide and poorly structured, providing less guidance to practitioners involved in the activity of SMI implementation. The relevant parts from the existing project management methodologies can be extracted according to the critical factors in the strategic manufacturing implementation area identified. Five generic project management methodologies were identified and analysed in Chapter 5 based on a seven category analysis and comparison system: philosophy, model, structure, outputs, tools and techniques, practice, and product.

Determining the seven categories for the SMI implementation methodology is a challenge for conceptual development and benchmarking against the key success factors identified. In realising this stage of the research, there are two main parts. First, to determine the seven categories that define the SMI implementation methodology, and second to describe the new methodology. This structure is illustrated in Figure 7.1 and discussed in the following sections.

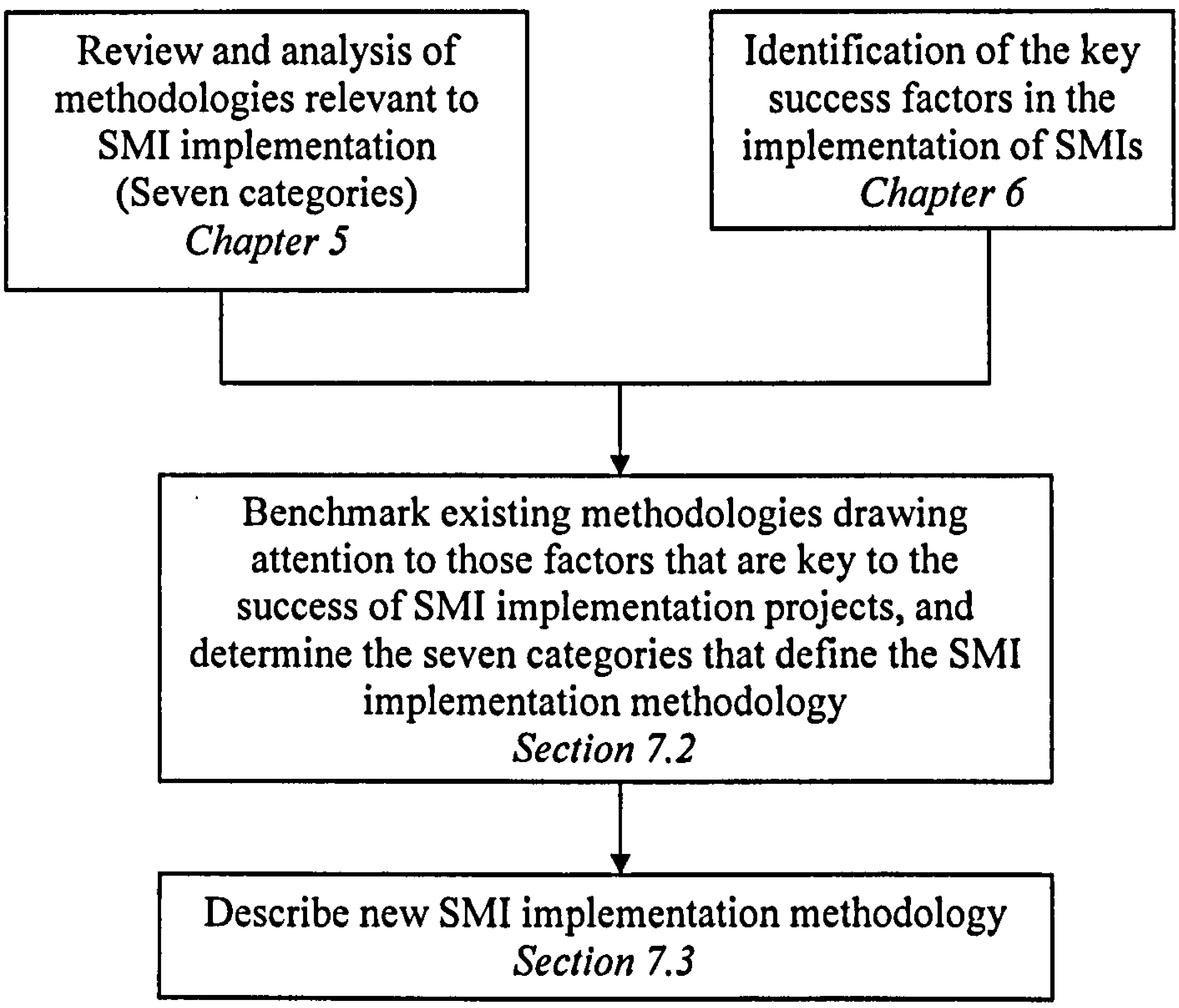

Figure 7.1: Formation of the Pilot Methodology

7.2 Formation of the SMI Implementation Methodology

This section sets out to establish the seven categories that define the new SMI implementation methodology. This section therefore illustrates how the categories are defined to form a new methodology. Sections 7.2.1 – 7.2.7 presents the conceptual development and benchmark against the key success factors identified for each one of the seven categories.

7.2.1 Philosophy of the Pilot SMI Implementation Methodology

The philosophy category refers to the principle or set of principles that underlie the methodology. These principles can be defined by the general objective of the methodology. The five methodologies analysed in Section 5.4 are designed to provide a framework covering a wide variety of disciplines and activities aimed to a broad type of projects in many industries. The objective of the SMI implementation methodology is to guide manufacturing practitioners in the successful and rigorous implementation of strategic manufacturing initiatives.

7.2.2 Model of the Pilot SMI Implementation Methodology

The model category refers to the kinds of abstraction used in the methodology. The model can be defined in terms of the area where the methodology is specifically designed to be applicable and the physical shape of the system. All the methodologies analysed in Section 5.4 are generic project management methodologies intended to be useful for most projects. Contrarily, the SMI implementation methodology draws attention to the most critical aspects specific to the strategic manufacturing implementation area.

The generic project management methodologies analysed are not structured in a step-by-step fashion but in sections covering specific areas, concepts and principles of the project management discipline. The pilot SMI implementation methodology is a step-by-step methodology that would guide practitioners in the rigorous implementation of SMIs.

7.2.3 Structure of the Pilot SMI Implementation Methodology

The structure category refers to the stages covered by the methodology. It also includes the arrangement of these stages. This section sets out to establish the structure of the new SMI implementation methodology. The first stage of the determination of the structure is based on the identification of the common phases identified in the review of existing methodologies described in section 5.4. The second stage would refine the structure proposed by benchmarking the stages identified against the key success factors presented in section 6.3.3.

Section 5.4 showed that in terms of similarities, all the methodologies analysed start with a number of sections incorporating an introduction, background to the methodology, purpose of the methodology, terms and definitions, and an overview of the structure of the publication. Most of the methodologies also include a project life cycle or proposed sequential arrangement of activities in project management. Then, the different areas of knowledge in the project management discipline are presented in different arrangements in each publication. The general observation is that there is an introduction to the methodology followed by five similar stages referring to the sequential arrangement of activities. These stages can be categorised into the following phases:

0. Introduction –Background, purpose, definitions and structure
1. Initiation –Understanding the purpose of the project
2. Planning – Defining activities, schedules, time, cost and resources
3. Execution – Carrying out project plan and relevant communication
4. Monitoring –Evaluating variances from the plans
5. Closure – Documenting and evaluating the project

The process of mapping the generic methodologies to the phases identified is illustrated in Table 7.1. The table demonstrates how the mapping was carried out to describe fully the generic structure. The top column of the table displays the numbers of stages covered by the methodologies. The left hand column outlines the methodologies.

	0	1	2	3	4	5
PMBOK	Introduction; The PM context; PM processes	Initiating	Planning; Facilitating	Executing	Controlling	Closing
BS 6079-1:2000	Scope; Normative references; Terms and definitions; The corporate aspects of project management; Project and company organisational structures	General; Introduction	Planning; Project management plan; Processes supporting the project management process		Control	
APM BOK	Introduction; General	Strategic	Control; Technical; Commercial; Organisational; People			
PRINCE2	Introduction; Introduction to PRINCE2; Introduction to processes	Starting up a project; Initiating a project	Planning	Directing a project	Controlling a stage; Managing product delivery; Managing stage boundaries	Closing a project
RISKMAN	Background to RISKMAN; Introduction to Project Risk Management	Analyse	Estimate	Organise	Follow up	

Table 7.1: Mapping of Methodologies against the Common Phases Identified

Having specified the common phases in the existing methodologies, these are then benchmarked against the key success factors identified in Section 6.3.3. The objective of the new SMI implementation methodology is to provide practitioners with a guide in the implementation of strategic manufacturing initiatives (Section 7.2.1). Therefore, the structure of the new methodology must focus on the key success factors identified.

In order to provide a uniform level of criticality during all the phases of the methodology, the different stages of the structure of the new methodology must address a similar number of those critical tasks and activities that most influence the success of the process. The common stages identified are mapped against the key success factors presented in Section 6.3.3 in order to refine and balance the structure of the new SMI implementation methodology.

The process of mapping the common phases of the methodologies against the key success factors is illustrated in Table 7.2. The top column of the table displays the numbers of the key success factors as presented in Table 6.2. The left hand column outlines the common phases identified. The right hand column shows the number of key success factors addressed by each one of the phases.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	TOTAL
INTRODUCTION						■			■								■	■		■	■								■						■		8
INITIATION		■			■				■						■	■		■		■					■									■			9
PLANNING	■		■	■	■	■	■			■	■		■				■	■	■	■	■			■	■	■	■	■	■	■	■	■				■	24
EXECUTION	■							■	■													■	■										■				6
MONITORING														■																						■	2
CLOSURE												■		■			■				■		■														5

Table 7.2: Common Stages of Methodologies against Key Success Factors

The results of the mapping process presented in Table 7.2 show that whereas the Planning stage addresses 24 key success factors, the Monitoring and Closure stage only deal with a total of 7 key success factors between them. The Introduction and Initiation phases seem to be better balanced addressing 8 and 9 key success factors respectively. Therefore, the structure of the new methodology has been refined based on the key success factors identified and a more balanced sequence of stages has been formed. The development of the structure for the pilot SMI implementation methodology from the common structure identified is illustrated in Figure 7.2, which shows the combination of common phases undertaken to develop the new structure. The number of key success factors addressed by each one of the phases is shown in brackets and it is also illustrated in Table 7.3.

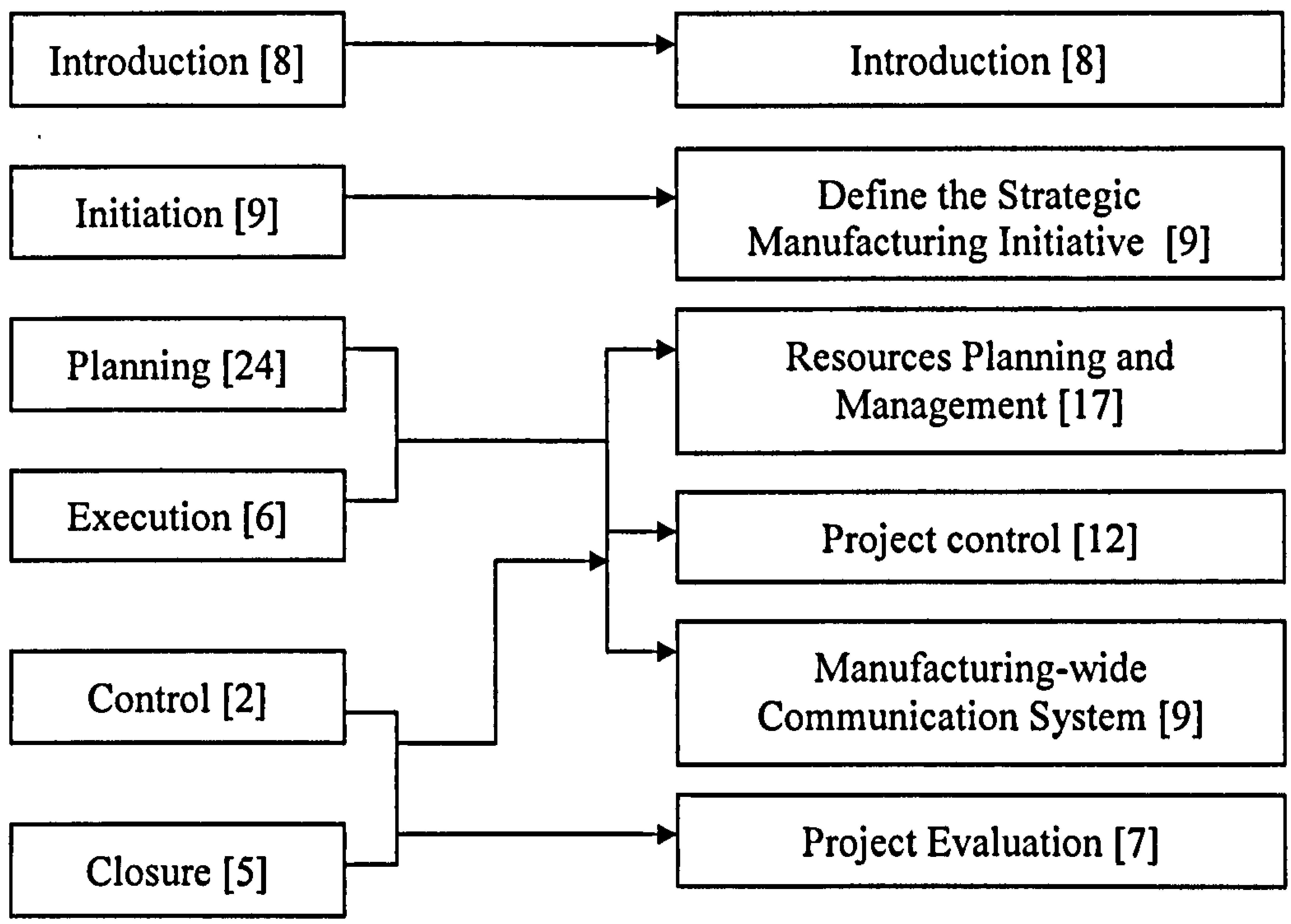

Figure 7.2: Development of the Pilot Structure

This section has defined the structure of the new approach on the basis of the common phases and the key success factors. The next two sections set out to determine the content of each stage in the form of outputs and tools & techniques.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	TOTAL
INTRODUCTION						■			■								■	■		■	■								■						■		8
DEFINE THE STRATEGIC MANUFACTURING INITIATIVE		■			■				■						■	■		■		■					■									■			9
RESOURCES PLANNING & MANAGEMENT	■			■	■	■	■			■			■				■		■		■			■	■	■		■	■		■	■					17
PROJECT CONTROL			■							■	■		■				■	■			■						■			■		■			■	■	12
MANUFACTURING -WIDE COMMUNICATION SYSTEM	■		■		■			■						■				■				■	■										■				9
PROJECT EVALUATION												■		■			■				■		■													■	7

Table 7.3: Key Success Factors addressed by the Stages of the Pilot Methodology

7.2.4 Outputs of the Pilot SMI Implementation Methodology

The outputs category refers to the deliverables of the methodology at every stage and in particular the nature of the final deliverable. Section 5.4 shows that each methodology is formed by a different sequence of sections that deliver a diverse list of outputs. The most comprehensive methodology is the PMBOK, which includes most of the outputs referred by the other four methodologies. The final deliverable of all the methodologies would be a project file including the outputs from each section of the methodologies.

The outputs of each phase of the pilot SMI implementation methodology are based on the key success factors identified and addressed by the phases illustrated in Table 7.3. The output from the new methodology includes the deliverables at each step of the methodology; this is referred to as outputs in the methodology workbook. Each output forms an input to the next section or step in the five-step methodology. These outputs are presented in Figure 7.3.

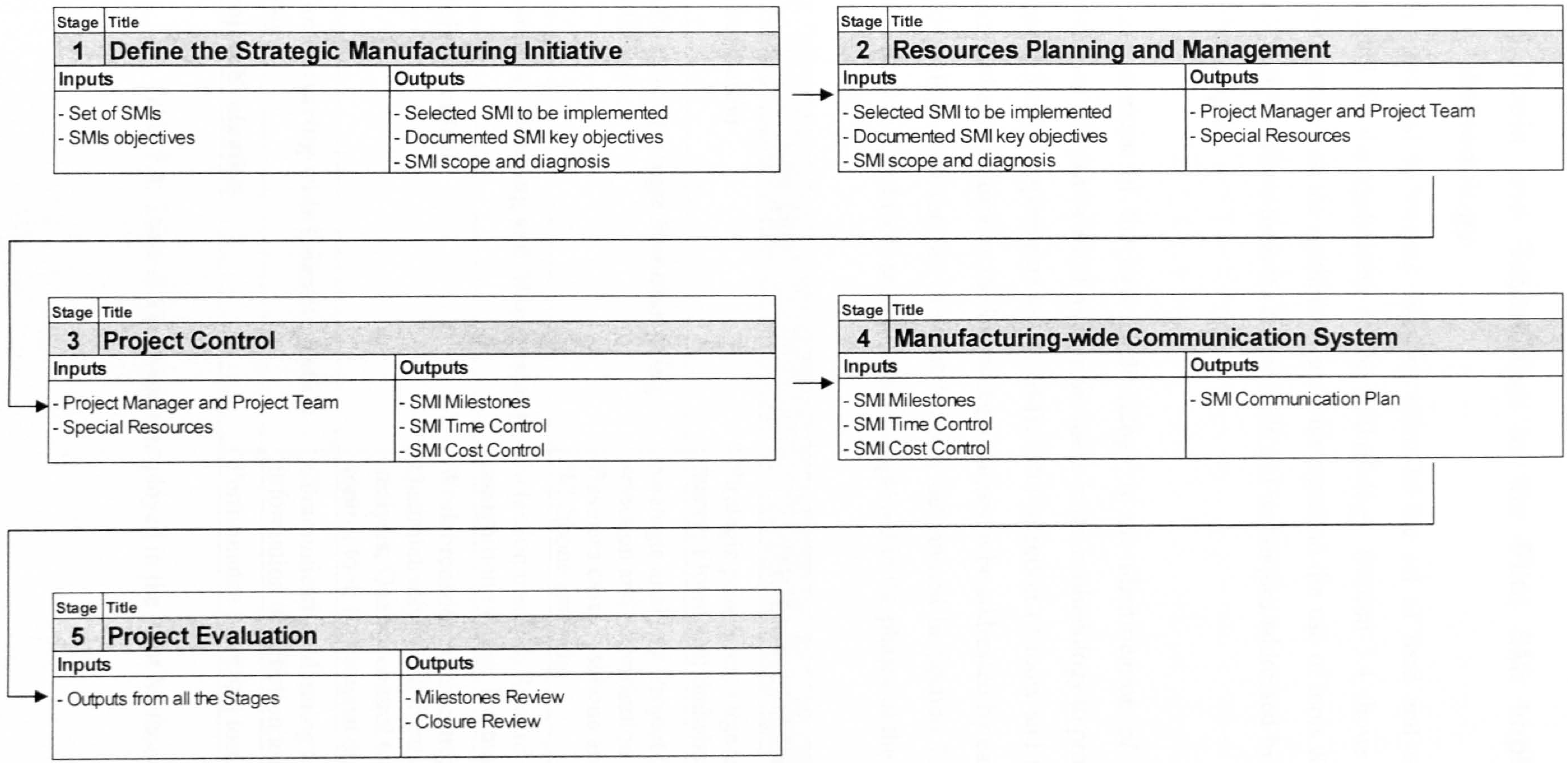

Figure 7.3: Outputs from the 5 Stages of the Pilot Methodology

7.2.5 Tools and Techniques in the Pilot SMI Implementation Methodology

The tools and techniques category refers to the set of hard and soft techniques included for the application of the methodology. Section 5.4 shows that the most comprehensive of the methodologies with regard to the use of tools & techniques is the PMBOK, which includes all the tools and techniques addressed by the other four methodologies.

A key element of the new methodology is the identification of the tools and techniques that can be employed by the users in the methodology to provide a suitable support for the implementation of SMIs. The selection of tools and techniques has been carried out based on the key success factors to be addressed by each stage of the methodology, and the list of inputs/outputs determined in Section 7.2.4. Table 7.4 illustrates the list of tools and techniques employed in the phases of the methodology.

STAGE	TOOLS & TECHNIQUES
Introduction	Strategic principles; Organisational theory; Flowchart; Stakeholder analysis
Define the Strategic Manufacturing Initiative	Strategic analysis; Project (SMI) selection and prioritisation method; Business case; Fishbone analysis; Wishbone analysis;
Resources Planning and Management	Selection method; Reward and recognition system; Estimating tools
Project Control	Work breakdown structure; Gantt chart; Quantitatively based durations; How-how analysis; Quality control tool; Cost control tool; Precedence diagramming
Manufacturing-wide Communication System	Communication planning tool; Information distribution tool
Project Evaluation	Performance reporting tool

Table 7.4: Tools & Techniques employed in the Pilot Methodology

7.2.6 Practice in the Pilot SMI Implementation Methodology

The practice category refers to the user base and therefore the participants, and the skill levels and experience required to use the methodology. Practitioners either experienced or new to the implementation of SMIs should easily follow the sequence of stages defined in the new methodology. The pilot SMI implementation methodology can be used in two ways. Firstly, to act as a step-by-step methodology for Senior Management, Project Managers and Project Teams involved in the implementation of SMIs, by providing guidelines, tools and techniques to assist in the management of the project. Secondly, it provides an overall view of the activities involved in SMI implementation projects for practitioners who wish to quickly familiarise themselves with this process. Table 7.5 presents a description of the roles included in the pilot SMI implementation methodology.

ROLE	DESCRIPTION
Senior Management	Level of management that have the capability to launch Strategic Manufacturing Initiatives, and influence and decide strategic decisions providing a high degree of support to strategic projects
Middle Management	People who manage functions or departments in the manufacturing organisation whose employees may be seconded to SMI implementation projects
Project Manager	People that drive, own and facilitate the methodology of Strategic Manufacturing Initiative implementation
Project Team Members	People who perform the implementation activities of the project, probably internal to the organisation
Manufacturing Employees	People internal to the organisation who are affected by the Strategic Manufacturing Initiative but are not directly involve in its implementation

Table 7.5: Roles in the Pilot SMI Implementation Methodology

7.2.7 Product of the Pilot SMI Implementation Methodology

The product category refers to what the methodology includes in terms of documentation, software, training, support, consultancy and the medium used to present and disseminate the methodology. The medium or vehicle that is used to present the pilot methodology to the intended audience is discussed in this section. This section describes the type and selection of delivery medium and the relevant design requirements.

An interesting and challenging decision in the SMI implementation process is the selection of the medium that will be used to present and disseminate the pilot SMI implementation methodology. Information on choice of delivery is surprisingly limited. This research has investigated media selection from the instructional design literature.

Instructional design is generally an accepted, systematic approach to the development of instructional materials. It is a structured process in which all parts are considered critical to successful learning (Dick and Carey, 1990). Two principal means of delivery were available for selection, a paper based or computer technology. Reiser and Gagne (1983) published a model showing how to select the best medium for self-instructional delivery systems. Based on this model, the designer uses the model by answering questions about the skill to be taught and then follows a flow diagram to the point that several candidate media are suggested. The technique is based upon a complete review of the research on the use of media in instruction. From the works of Dick and Carey (1990) and Gagne et al. (1988), the media employed are often chosen on grounds of:

- Availability of resources and personnel in the environment in which the methodology will be used
- Feasibility
- Convenience
- Flexibility
- Durability

- Cost effectiveness
- Learning task

Based on the above factors, the medium chosen to deliver the pilot methodology is a paper-based workbook, primarily based on ease of access and cost factors in the user environment. The objectives of the workbook are to:

1. Encourage all stakeholders to participate in the process of successfully and rigorously implementing strategic manufacturing initiatives
2. Promote a better understanding of the SMI implementation process
3. Guide the intended result of the delivery, communicate what each party is responsible for at each stage of the process, and how to do it
4. Take a systematic, project management based and procedural view of the implementation of manufacturing strategies and strategic manufacturing initiatives
5. Enable learning and knowledge transfer to occur
6. Achieve effectiveness, efficiency and appeal

A number of methodologies have been delivered through a workbook, for example Mills et al. (1995), Neely et al. (1996), Greswell (1998), Childe et al. (1999), Lettice et al. (1999) and Farrukh et al. (2000). Whilst workbooks have a number of advantages, they also have weaknesses. Bradford et al. (1999) observe that workbooks assume a sequential approach to a problem, based on analysis, design and implementation, all delivered in a textual format. Despite the differences, workbooks provide transfer of knowledge to the user in a structured way.

The next challenge in the product category of the methodology is to determine the requirements for the design of a workbook. Based on the works by Hidding (1997), Smart et al. (1996) and Plowman (1989), the design of a workbook should be user-centred and address the following key needs:

- The effective transfer of knowledge on manufacturing strategy concepts likely impacts the application of SMI implementation process, and the principles of the methodological approach

- Low cost
- Minimise the use of participant time
- Provide easy access to individual steps and support the sequential structure
- Learning theory is embedded in the design of a workbook whether the designer has incorporated it intentionally or not
- Knowledge transfer is assumed to take place as the user works through the workbook
- Target audience is assumed to include user team and project managers. Basic users will generally read the methodology to learn in detail directions on how to use the information for training. The experienced user will use the methodology to look up or to confirm steps for reference aid
- Effective user-friendly training material should pay attention to colour, white space, look and feel, language used and content arrangement

An overview of the selection of delivery medium, and the rationale for opting for a paper-based workbook format have been discussed. Finally, the section has outlined some of the design requirements used to develop the workbook to assist the application of the methodology.

7.3 Overview of the Pilot SMI Implementation Methodology

The Methodology is described by examining the process in terms of the structure and the steps. An overview of the methodology and structure is presented in Section 7.3.1. The five steps used are described in Sections 7.3.2 to 7.3.6.

7.3.1 Overview and Structure

A five-step practical methodology has been developed. The principal goal of the methodology is to guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives. The pilot methodology begins with a section named Introduction, that provides some basic concepts especially dealing with manufacturing strategy concepts, a guide on how to use the workbook, an overview of the methodology, and a summary of roles and responsibilities. Then, the pilot methodology consists of the following:

Step 1: Define the Strategic Manufacturing Initiative

Step 2: Resources Planning and Management

Step 3: Project Control

Step 4: Manufacturing-Wide Communication System

Step 5: Project Evaluation

The new SMI implementation methodology is embodied in a paper-based workbook for convenient presentation, dissemination and delivery. While the steps assume a linear progression, the methodology also allows practitioners to adopt an iterative approach. The methodology addresses the 'what' through the steps and activities, and 'how' by providing well-defined guidelines. Each stage in the SMI implementation process is described. Most stages have been broken down into two or more steps. In creating this handbook, a balance has been sought between providing sufficient guidance for an activity, but without introducing so much detail that the user becomes bogged down and frustrated. Hopefully, the sacrifices in detail are far outweighed by usability. Each stage in the SMI implementation process is described in terms of the following:

- Stage number
- Title
- Inputs
- Outputs
- Objective, and
- Steps.

Each second level step also determines the individuals responsible for the correspondent activities. This complete description for each stage is described in just one page, which again should aid usability. Due to the ongoing refinement to the methodology, a detailed description is not provided. The final methodology will be fully described in Chapter 10. The sections below provide a brief overview of the five steps.

7.3.2 Step 1: Define the Strategic Manufacturing Initiative

This step aims to scope, diagnose, identify the key objectives, evaluate and prioritise the Strategic Manufacturing Initiatives identified and proposed by Senior Management as a result of the manufacturing strategy formulation process. Defining and prioritising SMIs is probably the most critical phase of strategic project management. This step will provide the very critical focus to the project. By restricting the number of SMIs being implemented at any one time, the following advantages are likely to accrue:

- Critical mass of resources is more likely to be achieved
- Organisational attention and communication will be focused on a much smaller number of issues at any one time
- The organisation is less likely to wear itself out on many very difficult projects.

7.3.3 Step 2: Resources Planning and Management

The resources planning and management step aims to allocate and manage the human, machine and organisational resources to the project. Allocation and management of resources is a fundamental requirement of effective project planning and management. One of the most critical factors identified is the selection of the Project Manager and the Project Team members which should be allocated not to who happens to be available to the project but only to those who fit project roles

7.3.4 Step 3: Project Control

The project control step aims to define project milestones, determine and plan individual activities, estimate and control project costs, and plan and assure the quality process. The planning and control processes are needed to achieve the strategic objectives of the project and to optimise the whole process. Defining milestones is a critical factor in successful strategic project control.

7.3.5 Step 4: Manufacturing-wide Communication System

This step aims to plan and maintain a company-wide communication system throughout the duration of the project. Improving visibility of the actual benefits and of the progress of the project to the rest of the organisation is believed to be one of the best motivators for change and acceptance of the project, and one of the ultimate success factors of the SMI implementation project. Informed and consequently motivated individuals would more easily cooperate and contribute to the successful implementation of all the project activities.

7.3.6 Step 5: Project Evaluation

This step aims to build a project evaluation and review system. Project reviews are an indispensable part of good SMI implementation management, reassuring Senior Management that the strategic benefits required will be in fact delivered and giving the project manager the opportunity to share successes, receive an independent view on the effectiveness with which he is running the projects, and providing the occasion to make critical decisions that will affect the future achievement of the strategic benefits established.

7.4 Chapter Summary

This chapter explained the process of forming the pilot SMI implementation methodology. A five-step methodology was created by combining the structure and contents of the existing methodologies and benchmarking them against the key success factors in the implementation of SMIs in practice. An overview of the methodology, its structure and contents, the inputs and outputs to stages, and tools & techniques selected was provided.

The methodology is delivered in a workbook style tool. It provides not only a baseline, systematic and procedural guide for practitioners and organisations to follow; activities are well defined in structured steps, and supported by associated tools and techniques. The operation of the methodology and the workbook design requirements (Section 7.2.7) further explain the practical aspects of the application. It is proposed to further develop the workbook methodology after several reviews by practitioners and application in industry. The next chapter presents the results of interviewing four practitioners to evaluate and validate this pilot methodology.

Chapter 8: Primary Evaluation of the Methodology

The previous chapter described how the pilot SMI implementation methodology was created. The research programme in Section 4.3.1 has established the fourth stage of the research, namely the evaluation of the methodology. The objective and the method of this stage of the research are presented first. This is followed by describing the execution of the evaluation process. The results and findings from the validation are discussed. Observations from the study are highlighted and, finally, conclusions drawn.

8.1 Stage 4 Objective and Method

This section considers the methodology and the logic employed to undertake the evaluation process of the SMI implementation methodology. The objective of this stage of the research is to evaluate the pilot SMI implementation methodology. In realising this objective it was important to investigate practitioners' judgement and observations to the pilot SMI implementation methodology. Once the evaluation is carried out and the pilot methodology is refined, Stage 5 of the research will address the application of the methodology in industry settings. There are five parts to this stage of research: firstly, to determine the research method; secondly, to select suitable participants; thirdly, to design the evaluation method and execution; fourthly, to analyse the evaluation and observations; and finally, to make changes to the pilot methodology from the findings. The evaluation method is illustrated in Figure 8.1.

The stage considered three research methods: namely survey questionnaire, Delphi technique and interviews. The survey questionnaire approach is a way of contacting a large number of people to get their views (see Section 6.1.1). The main disadvantage of this method according to Oppenheim (1996) is the lack of opportunity to correct misunderstanding, to probe, or to offer explanations. So, if a response is not clear, little can be done to clarify this, because no interviewer is available (Zikmund, 1997).

The Delphi technique is a way of obtaining group input for ideas and problem solving from 'experts' in the field. The technique requires no face to face participation and essentially consists of three or more rounds to elicit information and feedback from the participants involved in the process. Whilst this approach predicts a reliable judgement and maintains anonymity of participants, it requires adequate time and participant commitment, and produces biased judgements of the selected group (Section 6.1.1).

An exploratory interview is a form of depth interviews, or free-style interviews. The primary objective is to maintain spontaneity. This method allows the interviewer to clarify responses when necessary, respondents can express themselves in their own language and the duration of the interview can be clearly determined. A small, in-depth interview was preferred for this stage of the research, because it allowed free discussion and enabled the generation of ideas.

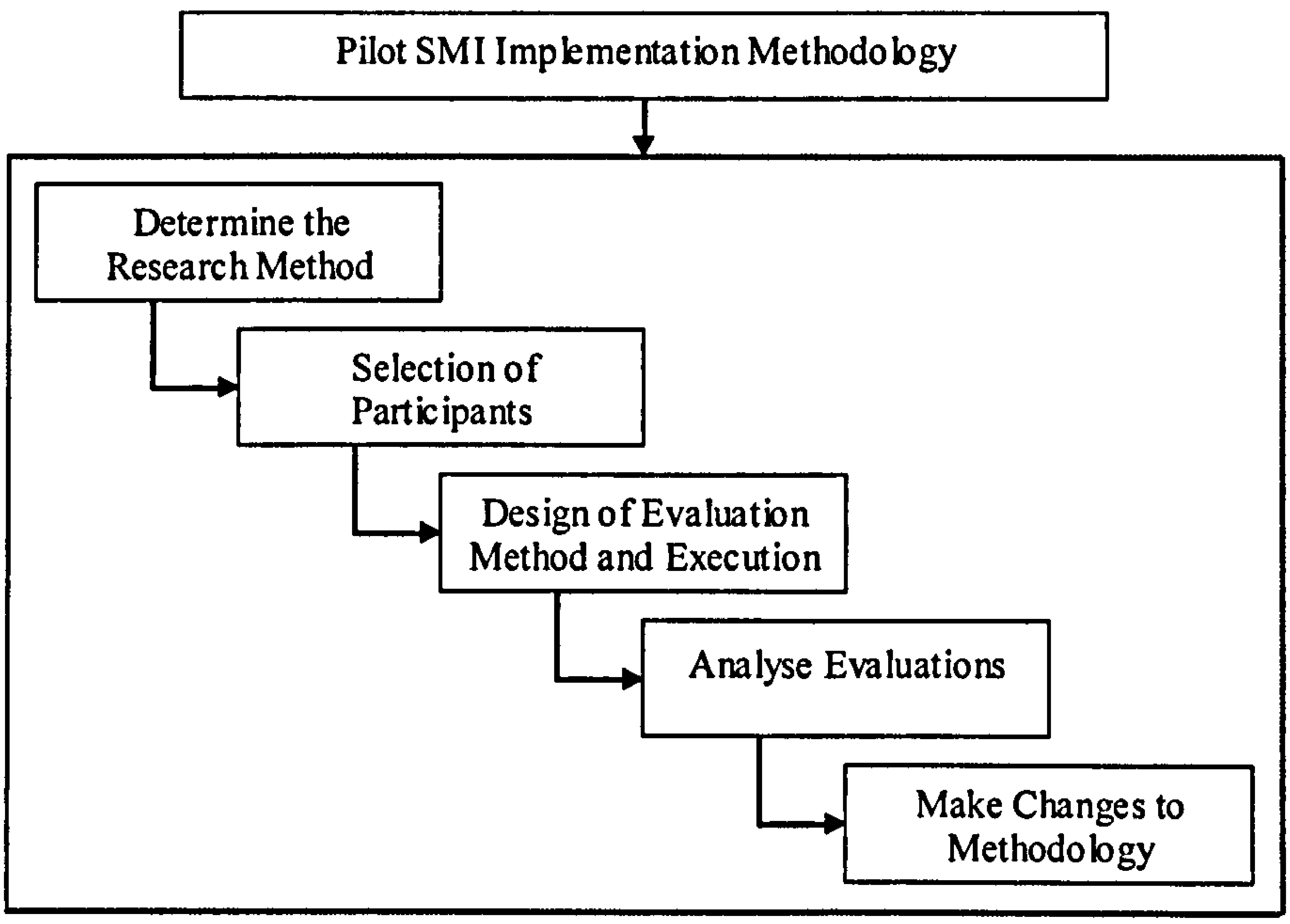

Figure 8.1: Evaluation Research Method

8.2 Selection of Participants

Once the method was determined, the next step was to decide on people to contact. A number of practitioners and companies were identified as appropriate to carry out the study based on two main factors: diversity of backgrounds of practitioners and companies. This mixture should provide a means to an evaluation from diverse previous experiences, practices in different industry settings and contexts. The final selection consisted of 4 practitioners in manufacturing firms. Table 8.1 shows the diverse characteristics of the 4 participating companies and practitioners in the evaluation process. The characteristics of companies are determined in terms of manufacturing product, years of operation, number of employees and revenue. Participants' characteristics are determined based on interviewee's position and years of experience. A telephone call was made to the appropriate individuals in order to detail the purpose of the study, the documentation that they would receive prior to the evaluation interview, the content of the interview and seeking an interview date. Appendix D presents further background information of the companies selected.

	Company A	Company B	Company C	Company D
Product	Tools and plastic mouldings	Zinc and aluminium die castings	Precision Engineered Components	Variable speed drives
Years of operation	43	14	32	31
Employees	400	35	140	520
Revenue	£23 m/annum	£5 m/annum	£7m/annum	£90 m/annum
Date of visit	March 2004	April 2004	April 2004	May 2004
Interviewee's position	Manufacturing Manager	Senior Process Engineer	Project Engineer	Production Manager
Interviewee's experience	18 years	11 years	4 years	8 years

Table 8.1: Characteristics of Participating Companies and Practitioners in the Evaluation Process

8.3 Design of Evaluation Method and Execution

This section describes the process taken to design the evaluation method for the SMI implementation methodology. It presents the design of the evaluation framework, the data collection method, and finally the execution of the evaluation.

8.3.1 Design of Evaluation Method

Two possible evaluation procedures were considered from the literature; first, NIMSAD (Normative Information Model-Based System Analysis and Design) and second, Platts' (1990) assessment criteria for testing manufacturing process research. The NIMSAD framework developed by Jayaratna (1994) emerged from problem solving in industry, consulting practice and action research. According to Jayaratna, the framework can be used to evaluate any methodology, not just information systems methodologies. The NIMSAD framework divides the methodology that is to be evaluated into the following four elements:

- The problem situation (the methodology context)
- The intended problem solver (the methodology user)
- The problem solving process (the methodology)
- The evaluation of the above (the evaluation questions)

Although the NIMSAD framework is good to use to identify the initial structure for the evaluation exercise, it does not provide the level of procedural analysis required in evaluating the SMI implementation workbook. Thus, the research decided against using it and instead, the procedural approach for assessing process research (Platts, 1990) was adopted, as described below.

Process research has generated increasing interest from strategy that focuses on the relationship between systems, decision processes, performance and operations management looking at the relationship between operational processes and performance as opposed to the traditional way of design and implementation processes (Chakravarthy and Doz, 1992). A process-based approach can play a considerable role in developing and testing a theory of process effectiveness and the use of a process based evaluation (Chapter 8) and application (Chapter 9) framework has the potential to develop value to practitioners if it is to be of relevance to the industry (Voss et al., 1994). Platts (1990) suggested that successful tests of any practical methodology should constitute:

Feasibility	–	Can the workbook SMI implementation methodology be followed?
Usability	–	Is the SMI implementation methodology workable?
Usefulness	–	Is the workbook methodology worth following?

The testing of feasibility is straightforward according to Platts. If each step in the methodology can be followed consistently as laid down, this demonstrated the methodology is feasible. The usability test addresses that for the methodology to be accessible to users and managers, the techniques and tools have to be relatively easy to use and user friendly. The testing of usefulness assesses the success following the completion of the methodology.

Asking the opinions of participants in the evaluation interviews provides an insight into the three methodology test areas proposed by Platts, and an initial refinement of the SMI implementation methodology can be carried out. The next stage of the research, presented in Chapter 9, will assess the application of the methodology in industry setting based on the same test areas identified.

8.3.2 Data Collection Method

In order to execute the evaluation, the next activity was to determine the research instruments needed to collect data. Within this research stage, several sources of data were taken into account. Having opted for the interview method, data was collected by carrying out a set of four semi-structured interviews with the participants in different locations. Evaluation interviews were conducted with a set of six questions to direct the flow of the discussion towards the three test areas identified, the provision of feedback for the initial refinement of the methodology, and the comparison of the methodology against other methods used by the practitioners. The questions addressed during the interviews, as shown in Appendix E, included:

1. FEASIBILITY.
   Could the methodology be followed?
2. USABILITY.
   How easily could the methodology be followed?
3. USEFULNESS.
   Would the methodology provide an output that meet users' expectation?
4. How would you improve this methodology?
5. What do you consider to be the strengths of this methodology?
6. What makes this methodology different from other methodologies that you have used?

The information sought from the evaluation process was analysed to provide a descriptive and general picture of the methods and tools used. The use of exploratory interviews and qualitative data analysis provided the research with the information needed to consider the evaluation and the initial refinement of the pilot SMI implementation methodology.

8.3.3 Execution of Evaluation Process

The evaluation interviews were carried out in the period March 2004 to May 2004. The backgrounds of the four participating companies are detailed in Table 8.1. The backgrounds of the companies are detailed in Appendix D. The block of interviews was aimed at gaining useful insights into the perception of practitioners involved in the implementation of SMIs with regard to the pilot SMI implementation methodology formed and presented in Chapter 7.

A set of four interviews was carried out with practitioners in the manufacturing field. The structure was based on open-ended semi-structured interviews. Each interview began with an introduction stating the objective of the session, followed by a discussion of the six evaluation questions identified. From the evaluation process, a wealth of information and knowledge was generated, which could be analysed to provide an evaluation for the pilot SMI implementation methodology.

8.4 Analysis of the Evaluation

This section presents an analysis of the open-ended semi-structured evaluation interviews. The findings only reflect the practitioners and organisations visited, and not all companies or manufacturing professionals. The results from each of the six questions discussed were analysed as follows.

- **FEASIBILITY. Could the methodology be followed?**
  Practitioners showed their positive opinions with regard to the feasibility of the methodology. The sequence of stages was found to be correct and the steps in every stage of the workbook were found to be clear and well defined. One the interviewees suggested that a more detailed overview of steps to be included in the 'Introduction' section would benefit the whole understanding of the content and order of the stages. Other interviewees observed that the formation of the project team was posterior to the acceptance of the project's objectives by the project manager, whereas the whole team should assess and accept the benefits, objectives and duration of the project in order to create the appropriate commitment to the success and results of the implementation.

- **USABILITY. How easily could the methodology be followed?**
  The workbook was found easy to follow by the practitioners. Their perception was that there was no need for external resources to facilitate the application. Two of the practitioners commented that some of the tools and techniques included would benefit from more detailed instructions, specifically the fishbone and wishbone analysis, for assistance to less experienced practitioners.

- **USEFULNESS. Would the methodology provide an output that met users' expectation?**

  All the evaluations concluded that the rigorous step-by-step workbook presented would benefit the whole implementation process. Practitioners commented that the application of the methodology would strongly contribute to the rates of success of SMI implementation projects. The four practitioners interviewed believed that the methodology was applicable to their organisations and that the tools and techniques included seemed to be useful and beneficial to the successful development of the project. The output of the workbook and all its stages were found appropriate and relevant.

- **How would you improve this methodology?**

  Two of the practitioners mentioned that the 'Define the Strategic Manufacturing Initiative' stage seemed to include superfluous work as it states that all the strategic manufacturing initiatives are to be scoped and diagnosed. This activity was found to be of little benefit as the prioritisation and selection of the SMI to be implemented was based on the strategic impact and the business case / current financial condition and not in the scope and diagnosis analysis. Thus, they concluded that only the SMI identified should be scoped and diagnosed. One of the practitioners suggested that some of the worksheets were cramped and some tables too small. He suggested a change to the format of the workbook to improve readability.

- **What do you consider to be the strengths of this methodology?**

  The strengths of the methodology identified by the practitioners are listed below.

  - No previous project management knowledge required
  - It creates a consistent standard for the implementation of strategic projects in manufacturing
  - It is relevant and specific to the needs of the strategic manufacturing field
  - It involves the implementation team as well as senior management in the implementation of the SMI

- It focuses the actions of the manufacturing function to the most strategically relevant efforts
- It creates a common understanding of the strategic objectives of manufacturing
- It makes all the implementation steps and the sequence of actions clear to everyone
- It addresses how to deal with changes and critical decisions in the implementation process

- **What makes this methodology different from other methodologies that you have used?**

  Three of the practitioners state that there is no formalised methodology in their companies addressing the implementation of SMIs. Practitioners in their companies would manage the SMI implementation projects according to their own management styles and personal skills. The most common systems for the control and report of SMI implementation efforts are based on minutes from meetings, action plans, and informal conversations.

  The fourth interviewee argues that his company uses a standard project plan template in a Gantt chart style format that is used for reporting progress to a steering group or senior management. The lack of project management methodology specific to the manufacturing process is apparent in all the organisations interviewed. Besides, projects strategically highly relevant to the manufacturing organisation are dealt with in a similar fashion to other operational initiatives.

In this section the results of the evaluation process have been presented. Practitioners indicated that the pilot SMI implementation methodology is feasible, usable and useful in principle. The evaluation also provided constructive feedback into the pilot methodology that was used to refine it (Section 8.5).

8.5 Initial Refinement to the Pilot Methodology

Through the evaluation process, a number of comments and opinions from practitioners in the field were obtained which could be used for refining the SMI implementation methodology. The changes identified are presented in Table 8.2. These changes were incorporated immediately, and the application of the refined SMI implementation methodology presented in Chapter 9 included these modifications. The refined methodology is still based on the five-stage approach. Changes have been made to the contents and style of the workbook.

Changes to the Pilot SMI Implementation Methodology	
1	A more detailed overview of stages has been included in the 'Introduction' section
2	The assessment and acceptance of SMI implementation benefits and duration has been added to the responsibilities of the whole implementation team
3	More detailed instructions for the application of tools and techniques have been added
4	The scope and diagnosis activities have been reduced to the SMI that is to be implemented
5	The format of the workbook has been modified to a landscape orientation

Table 8.2: Changes to the Pilot SMI Implementation Methodology

8.6 Chapter Summary

This Chapter has presented the fourth stage of the research programme, namely the evaluation process. The stage objective was realised through a series of activities. First, the research method was determined, followed secondly by the selection of suitable participants. Thirdly, the evaluation method was designed and executed, including the determination of the data collection method. Fourthly, the analysis of the evaluation and observations was carried out using a qualitative method. Finally, the changes performed to the pilot methodology from the evaluation were provided.

The outcome of this process was that the pilot SMI implementation methodology had been evaluated and refined. The methodology was evaluated against the criteria of feasibility, usability and usefulness. The results show that the practitioners interviewed positively evaluate the pilot SMI implementation methodology against the evaluation criteria determined.

Chapter 9: Secondary Evaluation of the Methodology

Chapter 8 discussed the results of evaluating the pilot SMI implementation methodology by seeking practitioners' judgement and the consequent refinement of the workbook. The fifth stage of the research programme is to apply and test the methodology in an industry setting to address the problems that are being faced in practice. The chapter is structured as follows. The objective and method of conducting this part of the research are first discussed. The design of the application method is then presented. The application of the methodology in the test case is explained followed by the results and the principle findings. Finally, the refinements to the methodology are discussed.

9.1 Stage 5 Objective and Method

The research aim presented in Section 4.2 is to develop a methodology to guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives. Four research objectives were identified in order to realise this aim (Section 4.2). The first three objectives have been fulfilled in Chapters 5, 6 and 7. The fourth and last objective of the research addresses the assessment of the methodology in two phases: firstly, the evaluation of the methodology by seeking practitioners' judgement (Chapter 8), and secondly the practical assessment of the methodology in industry settings. This means a rigorous testing and refinement of the methodology through application.

The overall goal of testing is to observe the application of the methodology in practice in order to evaluate whether it is workable, to determine whether the methodology provides a practical, procedural step in the activity of SMI implementation, and to make the methodology relevant to the real world. To address this goal, there are three objectives, namely:

1. To identify how the methodology could be used in practice
2. To identify any problems and difficulties with the methodology
3. To identify if the result is worth the effort and whether the methodology gives a useful output to the manufacturing organisation

In order to achieve an independent and rigorous testing of the methodology, it was considered necessary to adopt a case study method without the researcher intervention, because an alternative intervention research approach to carrying out the testing raises a number of issues. The use of intervention brings with it lack of objectivity and unbiased observation. The test is not repeatable and the researcher is not independent of the test (Platts et al., 1998; Eden and Huxham, 1996). Thus, the role of the researcher at this stage was very much an observer-as-participant, by maintaining frequent contacts with the people involved within the case study (Burgess, 1984; Gill and Johnson, 1997).

The following research method and design adopted throughout this chapter is presented. First, to describe the conduct of the case study method; second, to discuss the choice of test site; thirdly, to design the application and assessment method; fourthly, to describe the conduct of the case testing; and finally to present the results of the application and the final refinements to the methodology.

9.1.1 Case Study Method

A case study method has been adopted as the appropriate research method to carry out the testing (Yin, 1993). Many authors have employed this method as a useful research technique (Glaser and Strauss, 1967; Eisenhardt, 1989; Miles and Huberman, 1984; Yin, 1994). The case study approach refers to an in depth study or investigation of contemporary organisations in their real life context using multiple sources of evidence (Yin, 1994).

Adapting the case study design by Eisenhardt (1989) and the techniques outlined by Yin (1994), the following aspects to designing case studies were adopted. The SMI implementation methodology was applied within the sponsor company (Control

Techniques, Section 2.2) by an internal practitioner. The test based the evaluation on the project manager, the implementation team, and a sample of senior managers. In all, ten people directly involved with the implementation of a new strategic manufacturing initiative were assessed and interviewed. This formed the primary source of assessment data.

9.1.2 Choice of Test Site

This section justifies the selection of the test site for the application and assessment of the methodology. A single case study was used for the test. The following criteria were set to define the minimum requirements of a test-site:

- The test-site should be considering the implementation of a strategic manufacturing initiative
- The scope of the SMI implementation project should be big enough to test the validity of the SMI implementation methodology, but small enough to be carried out completely within three months to allow the analysis of data by the researcher
- The test-site should be willing to adopt a new structured approach for SMI implementation efforts

The sponsor company, Control Techniques, fulfilled the three requirements in June 2004. The sponsor provided a strategic manufacturing initiative for testing the implementation methodology, which was conducted for a period of two months. Details of the SMI implementation project can be found in Section 9.3. One limitation of using the sponsor company could be their willingness to prove the method successful. The research has overcome this situation by selecting a wide choice of individuals to confidentially assess the application of the methodology as presented in Section 9.1.1.

Having stated the objective and the method for carrying out this stage of the research programme, the next section presents the challenge of designing the application method and the assessment framework.

9.2 Design of Application and Assessment Method

This section describes the process taken to design the assessment procedure for testing the SMI implementation methodology as part of the case study.

9.2.1 Research Design Overview

The purpose of this section is to establish the design method for the assessment framework. An assessment methodology has to be an organised and systematic procedure which involves people in a participative manner, both in basic data collection and joint discovery through its subsequent analysis, leading to creatively identifying improvement opportunities (Platts, 1990). In order to evaluate the effectiveness and success of the SMI implementation methodology, an assessment framework was developed, based on previous literature in the provision of methodological workbooks (Adesola, 2002; Platts, 1990; Neely et al., 1996; Chiesa et al., 1996).

Through using the methodology there will be, firstly, an outcome or content to an organisation, which the researcher wants to measure to see if this output is satisfactory and useful to the organisation. Secondly, there will be a pool of information and knowledge to refine the methodology. There are criteria by which to assess the success of the process and the outcome, and indicators to help assess those criteria. The process of assessment design presented in this section is illustrated in Figure 9.1. It adopts the input, process, output, controls and enablers approach to facilitate the evaluation of the methodology (Pettigrew and Whipp, 1991). The whole framework is carried out within a single case study (Yin, 1994) as discussed in Section 9.1.1.

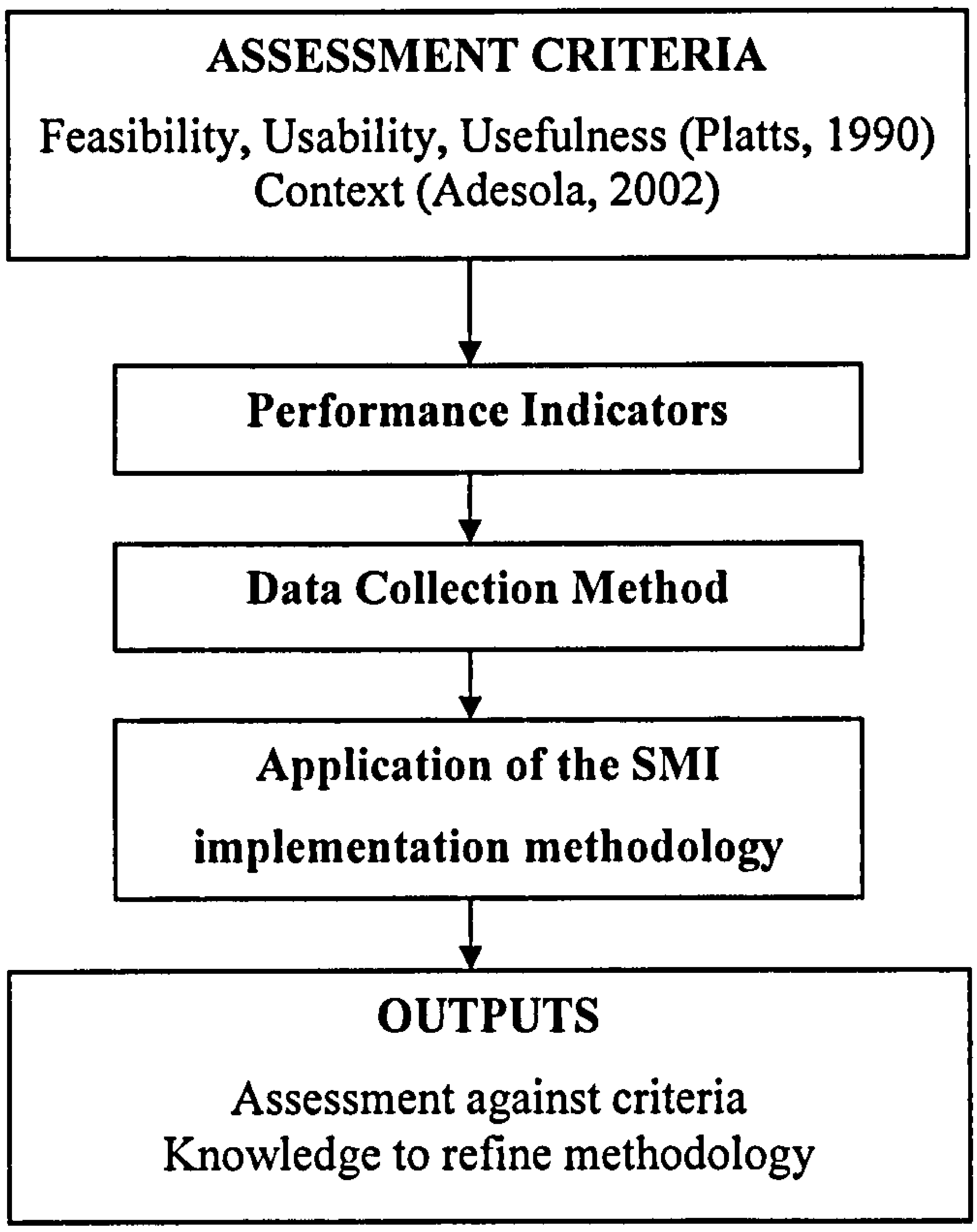

Figure 9.1: Research Design for Application and Assessment

The goal of the application was to test the use of the SMI implementation methodology, and to establish whether it was feasible, usable and useful in an industrial setting. These three assessment criteria have been described fully in Section 8.3. A fourth assessment criterion has been added, context, from the work of Adesola (2002) who argues that a methodology may mean different things in different organisations. Measuring contextual factors can help to analyse the outputs of the application of a methodology in a specific organisation. Adesola (2002) adapted Pettigrew's (1992) definition of context to business process research and this is interpreted to mean the capability of the organisation to apply the methodology. Context is measured by looking at factors internal and external to the organisation that may impact on the use of the methodology and its outputs.

Once assessment criteria were defined, it was necessary to formulate a set of performance indicators (Figure 9.1) that would measure whether the methodology was performing well. From this, twelve performance indicators were established. The definitions of each of the indicators and the criteria that they assess are provided in Table 9.1.

CRITERIA	PERFORMANCE INDICATORS	DEFINITION
FEASIBILITY	Completeness	Level of completion of all the stages in the workbook
	Adherence	Degree of closeness between project development and stages in the workbook
	Contingency	Capability of the methodology to cope with different scenarios faced during the life of the project
USABILITY	Ease of use	Degree of usefulness of all the stages and tools in the methodology
	Understanding	Number of problems encountered following the methodology
	Flexibility	Extent of changes made to the methodology during its application
USEFULNESS	Efficiency	Degree of resources (people, time) required to apply the methodology
	Effectiveness	Level of correlation between a successful output and the application of the methodology
	Satisfaction	Degree of approval and willingness to use the methodology again
CONTEXT	Experience	Familiarity with the application of structured methodologies
	Organisational structure	Management and functional reporting structure
	Business environment	Existence of recent changes in policies that may impact on the use of the methodology

Table 9.1: Performance Indicators in the Application of the Methodology

9.2.2 Data Collection Method

Having established what data to collect (Table 9.1), the purpose of this section is to determine the data collection method. Table 9.2 presents the data collection framework designed for this stage of the research. It addresses the following:

- When: When should data be sought?
- Who: From whom should data be collected?
- How: How should data be collected and what form of data collection should be used?

<table>
<tr><th>CRITERIA of ASSESSMENT</th><th>When
When should responses be sought?</th><th>Who
Who should provide responses?</th><th>How
How should data be collected?</th></tr>
<tr><td>FEASIBILITY</td><td>Post completion</td><td>Project Manager</td><td>Post Completion Questionnaire</td></tr>
<tr><td rowspan="2">USABILITY</td><td>Ongoing</td><td rowspan="2">Project Manager
Senior Management
Team Members</td><td>Researcher Observation</td></tr>
<tr><td>Post completion</td><td>Post Completion Questionnaire</td></tr>
<tr><td>USEFULNESS</td><td>Post completion</td><td>Project Manager
Senior Management
Team Members
Other employees</td><td>Post Completion Questionnaire</td></tr>
<tr><td>CONTEXT</td><td>Pre and Ongoing</td><td>Senior Management</td><td>Researcher Observation and Post Completion Questionnaire</td></tr>
</table>

Table 9.2: Data Collection Framework

Questionnaire-based interviewing techniques and researcher observation have been identified as the most appropriate research instruments to gather qualitative and quantitative data in order to assess the application (feasibility, usability, usefulness) and context of the methodology. Primary and secondary sources of evidence in line with Yin (1994) were employed during the research project. Questionnaires were developed to collate quantitative data and the level of importance (Morse, 1994; Yin, 1994; Patton, 1990; Strauss and Corbin, 1990).

Questionnaire Design and Validation

A principal method for collecting test evaluation data within the case study was through questionnaires. Churchill's (1998) nine-step guidelines to develop a sound questionnaire were followed (detailed in Section 6.2).

1. *Information sought.* Presented in Table 9.1 and discussed in Section 9.2.1.
2. *Type of questionnaire.* A paper-based questionnaire was selected because of the relatively low number of respondents required and the consequent ease of data processing and analysis.
3. *Individual question content.* A total of 12 performance indicators have been identified. Questions were designed to match the performance indicators established (Table 9.3)
4. *Forms of response.* For the purpose of this study it was decided to adopt an approach that would allow respondents to quantitatively reflect their opinions. The scale used in the questionnaire was based on the seven-point Likert (1932a, 1932b) scoring system. The Likert scale was used because it effectively measures the level of feeling and attitude to the question, it is relatively easy to construct and administer, and the respondents find them easy to answer due to response categories allowing an expression of the intensity of their attitude (Malhotra, 1993). As a result of the questionnaire pre-testing performed in step 9 of Churchill's guidelines, the scale was reduced to five points.

PERFORMANCE INDICATORS	QUESTIONS
Completeness	Were all the steps in the methodology completed?
Adherence	Did the project follow the workbook methodology?
Contingency	Was the methodology capable of coping with the different scenarios faced during the life of the project?
Ease of use	Did you find the stages and tools helpful?
Understanding	Did you encounter any problems following the steps?
Flexibility	Were any modifications made to the methodology?
Efficiency	Did the project consume excessive resource of time and people?
Effectiveness	Was a successful output a function of using the methodology?
Satisfaction	Would you use the methodology again?
Experience	Have you used a structured methodology previously?
Organisational structure	Is there a flat or hierarchical organisational structure?
Business environment	Have there been any recent changes in policies that may impact on the use of the methodology

Table 9.3: Individual Question Content matching Indicators

5. *Question wording.* To ensure clarity and lack of bias, attention was given to the wording of the questions. The questions were designed so that they were simple, unambiguous in their wording and the language used, neutral and in no way leading or implicitly seeking preferred responses (Payne, 1979; O'Brien, 1984; Schuman and Presser, 1996).

6. *Sequence of questions.* The structure of the questionnaire is divided into the criteria established: Feasibility, usability, usefulness, and context.
7. *Physical characteristics of the questionnaire.* The questionnaire concentrates on functionality, as the researcher will fill it in during the questionnaire-based interviews.
8. *Re-examination and revision.* The seven steps outlined previously were carried out. Each step was revisited and considered.
9. *Questionnaire pre-testing.* The pre-test of the questionnaire considers two separate issues, the content and the face validities. Content validity refers to how adequately the contents of the questionnaire reflect the information sought. Face validity testing considers whether or not the scales appear to be applicable and satisfactory. These two dimensions were addressed with researchers at Cranfield University and the sponsoring organisation. The main changes concerned the scale used which was reduced from 7 to 5 points.

Researcher Observation

Yin (1994) emphasises the importance of observation in case study research. The researcher was directly implicated as an observer in every stage of the implementation process. The researcher was a witness in the process and shared the team members' experiences. Validity of observation is often a challenge, and to reduce bias from subjective interpretations of situations (Denzin, 1989), the researcher crosschecked findings from the project participants and eliminated inaccurate interpretations (Adler and Adler, 1987).

In this section, an assessment framework has been developed. The framework determines the evaluation criteria, the sets of questions and performance indicators, and the research instruments to implement the evaluation procedure within an organisation.

9.3 Conducting the Application of the Methodology

The purpose of this section is to describe the experience, success, problems and issues concerned with using the SMI implementation methodology in industry settings. The section provides a background to the case study project, an overview of the use of the methodology and its subsequent validation.

9.3.1 Background of Case Study

The case is part of a new global distribution management system in Control Techniques (CT). CT has been presented in Section 2.2 as a world leader in the development, manufacture and application of AC and DC variable speed drives, servos and control systems. CT operates through a worldwide network of strategically placed drive and application centres focussed on the distribution and application of variable speed and motion control products and systems. Control Techniques' manufacturing plant is based on the Mochdre Enterprise Park, Newtown (Wales), in a purpose-built 13,000 square metre site. The Newtown manufacturing plant carries out two main activities: The manufacture of printed circuit boards, and the assembly and packing of the finished product, the drive.

Drives are distributed from the manufacturing plant to internal customers (i.e. drive and application centres) in the five continents, and to external end customers directly in those countries in which CT drive centres are not present. Drive centres sell and install drives usually integrated in automation systems to end customers. The more than 40 drive and application centres throughout the world hold diverse levels of stock of the more than 50 finished products and their variants in order to meet end customers' expectations of off-the-shelf availability of drives. Drive centres then replenish their stocks by placing orders to the UK manufacturing plant.

The re-stocking policies of drive centres are different and internally developed by the local management units. There are a number of issues resulting from this strategy as described below:

- The manufacturing plant receives the vast majority of the monthly sales orders in the first week of the month when drive centres evaluate their stocks and place orders. As a consequence, manufacturing delivery lead times are artificially high as it is not financially efficient in terms of labour capacity and inventory figures to design the flexibility of the manufacturing system to cope with these very frequent and not real extreme peaks in demand. Therefore sales orders dating is then spread throughout the month in a fairly flat daily production rate as shown in Figure 9.2.

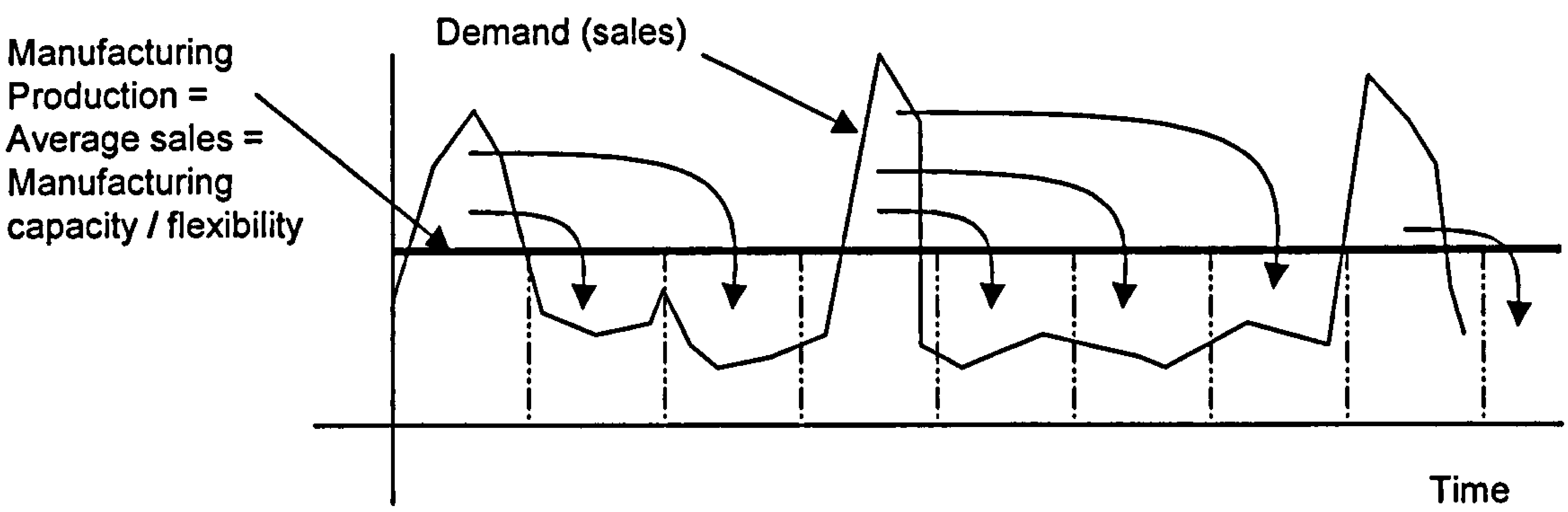

Figure 9.2: Sales Orders Dating against Flat Production Rate

- When the manufacturing plant is not capable of delivering a certain specific product, drive centres place high 'panic orders' that further push lead times and make the recovery from the sales overdue situation extremely difficult if not impossible.

As a result of a strategic manufacturing formulation and analysis, one of the strategic manufacturing initiatives that CT Senior Management in conjunction with the Strategic Business Development Manager identified was the so called Demand Led Distribution (DLD) initiative. This initiative had been envisaged to control more effectively the stocks of finished products around the world and to flatten the sales demand pattern faced by the manufacturing plant. DLD is a set of principles by which manufacturing takes ownership of the replenishment of stocks in drive centres. The objective of this initiative was to close the strategic gaps between customer requirements and manufacturing performance in terms of delivery lead time, reliability of delivery, and volume and mix requirement changes.

A formal presentation was made to the management team in May 2004 who agreed that the research project should be undertaken. The estimated timescale of the project was initially agreed for 2 months. The strategic manufacturing initiative chosen as the focus of the test study was the development and integration of demand led distribution principles into the operational procedures of the manufacturing plant. This began in June 2004 and was completed in July 2004. Control Techniques Senior Management recognised the strategic importance of the successful implementation of this initiative, and acknowledged the need and the potential benefits of using for the first time a strategic manufacturing initiative implementation methodology in CT.

9.3.2 Overview of Application of SMI implementation methodology

An overview of the application of the SMI implementation methodology to the case project is provided. The application was aimed at testing feasibility, usability and usefulness of the methodology. Two main research instruments were applied during and post application as described in Table 9.2: researcher observation and post completion questionnaire. By analysing the information gathered on what happened during the implementation process by the researcher and the senior management, project manager, and project team members an evaluation of the methodology was produced.

The case study was initiated in June 2004 and senior management, project manager and project team members followed the stages, tools and techniques from the workbook methodology. A full evaluation of the methodology was performed. Once the Production Planning Manager was selected as the project manager by senior management following the workbook guidelines, a 2 hour meeting was held by senior management to introduce the content and process of the workbook methodology to the project manager, and to present the initial strategic / financial benefits and estimated duration of the implementation (Stage 1 of the workbook). The project manager then proceeded to select the project team members according to the methodology. Appendix F shows how each stage of the workbook was applied by all the parties involved in the implementation of the Demand Led Distribution strategic manufacturing initiative.

9.4 Evaluation Results of SMI Implementation Methodology Application

The results from testing the SMI implementation methodology are presented in this section based on the post completion questionnaire and researcher observation addressing the evaluation criteria of feasibility, usability, and usefulness and considering the context factor. The testing of feasibility involved checking that the SMI implementation approach was followed. The testing of usability looked at how the workbook methodology was carried out, identifying problems, and looking at the way in which the methodology was organised. The testing of usefulness considered how well the methodology addressed the SMI implementation objectives and what the perceptions were of its influence on the overall success of the implementation. Following the completion of the test case, both quantitative and qualitative analysis were carried out.

Project team members, project manager, and senior managers were addressed individually to obtain their overall views on the performance of the methodology and its impact on achieving results. A face-to-face approach was considered the best option against a joint session to gather information based on the questionnaire developed in order to ensure independence of opinion and a more relaxed environment. A two page questionnaire was created including the four evaluation criteria determined (Appendix G).

The purpose of the post completion assessment was to provide a way of recording the overall performance of the methodology on all the criteria established for the application and assessment of the workbook. Quantitative questions were rated on a 5-point scale (5 being the most positive response, 1 being the most negative response and 3 being don't know). The total percentage against each criterion is calculated as follows: the sum of scores is divided by the maximum possible score given to the total number of questions by all the respondents. Table 9.4 illustrates the quantitative results of the post completion questionnaire. The following represents the comments and evaluations made.

9.4.1 Feasibility Results of the Application of the Methodology

The feasibility criteria was intended to prove that the methodology can be followed. The company followed the methodology and this demonstrates that it is feasible. A total of 3 questions were asked to evaluate the feasibility of the methodology:

1. Were all the steps in the methodology completed?
2. Did the project follow the workbook methodology?
3. Was the methodology capable of coping with the different scenarios faced during the life of the project?

Senior managers, project manager, and project team members rated the feasibility of the methodology as 72% (Table 9.4). The participants' perception of the feasibility of the methodology was very good. The worst rated aspect regarding the feasibility of the methodology was given to its capacity to cope with the different scenarios faced during the life of the project. Most of the participants, 6 out of 10, felt that the methodology did not provide a solution for every eventuality faced during the project life. At the same time they thought that adding more detail to the content of the workbook would reduce its feasibility. Table 9.5 summarises the comments made by the participants regarding the feasibility test during the post completion questionnaire.

	QUESTIONS									
	FEASIBILITY			USABILITY			USEFULNESS			
	1	2	3	4	5	6	7	8	9	
Senior Manager 1	4	2	4	4	4	4	2	2	4	67%
Senior Manager 2	5	4	4	5	4	4	4	4	4	84%
Senior Manager 3	5	4	4	4	4	4	2	2	2	69%
Senior Manager 4	5	5	2	4	5	4	2	4	4	78%
Project Manager	4	4	2	4	4	4	4	2	5	73%
Team Member 1	5	4	2	4	4	2	2	4	4	69%
Team Member 2	5	4	1	4	2	4	2	2	4	62%
Team Member 3	4	2	2	2	2	2	4	1	4	51%
Team Member 4	4	4	4	5	4	4	2	2	2	69%
Team Member 5	5	2	2	4	4	4	4	4	4	73%
RESULTS	92%	70%	54%	80%	74%	72%	56%	54%	74%	
	72%			**75%**			**61%**			**70%**
	FEASIBILITY			**USABILITY**			**USEFULNESS**			

Table 9.4: Results of the Post Completion Questionnaire

	QUESTIONS		
	FEASIBILITY		
	1	2	3
Senior Manager 1	[4] "Yes, except the team members' incentive sheet"	[2] "Partly because the workbook does not include technical documentation"	[4] "Mostly"
Senior Manager 2	[5] "Yes"	[4] "Mostly"	[4] "Mostly"
Senior Manager 3	[5] "Yes"	[4] "Mostly"	[4] "Mostly"
Senior Manager 4	[5] "Yes"	[5] "Yes"	[2] "Partly, the methodology was not relevant during some middle parts of the implementation project"
Project Manager	[4] "Yes, except 1.1 as it was decided beforehand and incentives sheets"	[4] "Mostly"	[2] "Partly, the methodology was not adding much during some middle parts of the implementation project"
Team Member 1	[5] "Yes"	[4] "Mostly"	[2] "Partly"
Team Member 2	[5] "Yes"	[4] "Mostly"	[1] "No, the workbook does not apply change management techniques"
Team Member 3	[4] "Yes, except the team members' incentive sheet"	[2] "Partly because 4.2 training plans were not rigorously followed"	[2] "Partly"
Team Member 4	[4] "Yes, except the team members' incentive sheet"	[4] "Mostly"	[4] "Mostly"
Team Member 5	[5] "Yes"	[2] "Partly"	[2] "Partly"
RESULTS	92%	70%	54%
	72%		
	FEASIBILITY		

Table 9.5: Feasibility Results - Participant's Comments

9.4.2 Usability Results of the Application of the Methodology

The measure of usability was also tested post completion and here the researcher sought both quantitative and descriptive statements from the project manager, senior managers and project team members. The usability criteria was intended to prove that the methodology can be easily followed. A total of 3 questions were asked to evaluate the feasibility of the methodology:

4. Did you find the stages and tools helpful?
5. Did you encounter any problems following the steps?
6. Were any modifications made to the methodology?

Based on the three quantitative questions, the usability of the methodology was rated as 75% (Table 9.4). The rating was very positive. The comments showed in Table 9.6 concentrate on the usability problems or issues raised by the participants that will be used to further refine the methodology in Chapter 10. The most common issues raised were that the team added a technical documentation section, senior management removed the team members' incentive sheet, cost control was not considered necessary for this project, quality control activities were not used, and the SMI prioritisation stage was not required as DLD was the only SMI considered.

	QUESTIONS		
	USABILITY		
	4	5	6
Senior Manager 1	[4] "Mostly, I don't agree with the team members' incentive sheet and it lacks a step about documentation and its management"	[4] "Very few, it is well laid out. The main concern is the lack of standardisation of the business case"	[4] "Very few, the team added the technical documentation section and removed the cost estimation step"
Senior Manager 2	[5] "Yes, specially the strategic relevance"	[4] "Very few"	[4] "Very few, the SMI prioritisation was not needed as it was the only SMI"
Senior Manager 3	[4] "Mostly, because some were decided before starting the workbook"	[4] "Very few, mostly with the cost estimation stage"	[4] "Very few, the cost estimation stage was removed"
Senior Manager 4	[4] "Mostly, because some were very obvious"	[5] "No / Not at all"	[4] "Very few, a technical documentation section was added and the milestones reviews were not formalised"
Project Manager	[4] "Mostly, I don't think that project managers' incentives should be publicised"	[4] "Very few, mainly the quality control activities were not fully understood"	[4] "Very few, we removed the quality control activities, project team members' incentives and prioritisation of SMIs. We added the technical documentation section"
Team Member 1	[4] "Mostly"	[4] "Very few, most of it was OK"	[2] "Many, no incentives' sheet, no SMI prioritisation"
Team Member 2	[4] "Mostly, it should consider more project change management tools"	[2] "Many, it was lacking of more detailed explanations of tools such as the fishbone analysis"	[4] "Very few, we added technical documentation"
Team Member 3	[2] "Partly, I doubt the utility of the team members' incentive sheet"	[2] "Many, quality control and unintended opportunities were not clear"	[2] "Many, incentives' sheet were removed"
Team Member 4	[5] "Yes"	[4] "Very few"	[4] "Very few, no team incentives' sheet "
Team Member 5	[4] "Mostly, very concise set of tools"	[4] "Very few, long introduction"	[4] "Very few, technical documentation added"

RESULTS	80%	74%	72%
	75%		
	USABILITY		

Table 9.6: Usability Results – Participants' Comments

9.4.3 Usefulness Results of the Application of the Methodology

The measure of usefulness of the methodology was intended to determine the perceived success of the workbook and the outcome of the strategic manufacturing initiative implementation effort. A total of 3 questions were asked to evaluate the feasibility of the methodology:

7. Did the project consume excessive resource of time and people?
8. Was a successful output a function of using the methodology?
9. Would you use the methodology again?

All indications pointed to the fact that the methodology was perceived as very good by the project manager and senior managers. Project team members were more disperse in their usefulness evaluations. The overall feedback from the interviews on the usefulness of the methodology was positive; on the whole 61% was recorded (Table 9.7). The net result is that, using the SMI implementation methodology in industry settings by practitioners, the SMI has been successfully implemented.

On the point of whether they will use the methodology again in the future, 8 out of the 10 participants expressed their positive intentions of applying the methodology to guide future SMI implementation efforts with minor or no modifications. This response proves that the methodology has been perceived as useful by practitioners. Additional refinements would further increase the participants' recognition of usefulness. The project manager's personal skills have been emphasised as critical for the success of the implementation effort, in a similar fashion as it was identified in our worldwide survey of practitioners to identify the key success factors in the implementation of strategic manufacturing initiatives (Sections 6.3 - 6.4).

	QUESTIONS		
	USEFULNESS		
	7	8	9
Senior Manager 1	[2] "Many, but the outcome was worthwhile"	[2] "Partly, the project managers' skill played an important role"	[4] "Mostly, with some minor modifications"
Senior Manager 2	[4] "Few, but necessary"	[4] "Mostly, the understanding of what and when stages would happen was very helpful"	[4] "Mostly, with some minor modifications"
Senior Manager 3	[2] "Many, too much senior management time spent in reviews"	[2] "Partly, the definition of the SMI was key for the success too"	[2] "Partly, if it is further refined"
Senior Manager 4	[2] "Many, benefits agreed was time consuming"	[4] "Mostly, it helped to focus team resources"	[4] "Mostly, with some minor modifications"
Project Manager	[4] "Few, the necessary and I think the workbook kept resources efficiently utilised"	[2] "Partly, project manager's abilities are still critical. It is great for team members"	[5] "Yes"
Team Member 1	[2] "Many, a lot of meetings"	[4] "Mostly, very clear sequence of actions"	[4] "Mostly, with some minor modifications"
Team Member 2	[2] "Many, and difficult to share with functional role"	[2] "Partly, people management and motivation cannot be in a methodology"	[4] "Mostly, with some minor modifications"
Team Member 3	[4] "Few, mainly in the scope stage"	[1] "No, a similar sequence of stages would have been followed anyway"	[4] "Mostly, with some minor modifications"
Team Member 4	[2] "Many, but beneficial"	[2] "Partly, the SMI was quite straightforward"	[2] "Partly, I would change a few stages"
Team Member 5	[4] "Few, it was good"	[4] "Mostly, good easy tools"	[4] "Mostly, with some minor modifications"

RESULTS	56%	54%	74%
	61%		
	USEFULNESS		

Table 9.7: Usefulness Results – Participants' Comments

9.4.4 Context Results of the Application of the Methodology

The objective of analysing the context in the application of the methodology is to identify whether there have been any factors internal or external to the organisation that may have impacted on the use of the methodology and its outputs. Few issues arose during the interviews, as during the two months of methodology application there were no significant changes of any kind in the organisation. Most of the team members (4 out of 5) argued that it was the first time that they had used a structured methodology whereas the other participants had used them before in new product introduction projects, quality function deployment systems, and business, marketing and manufacturing strategy formulation. The organisation structure is based on a traditional hierarchical system and participants did not identify any influence of this factor on the application and outcome of the methodology.

9.4.5 Researcher's Observations from the Application of the Methodology

This section addresses the general observations of the researcher from the application of the methodology. This was achieved through the observations recorded during the application by the researcher as observer. The researcher, during the implementation project, assisted at all the meetings and qualitatively tracked the progress of the project and the use of the workbook methodology at each stage. The documentation resulting from the application of the workbook is presented in Appendix F.

Stage 1: Define the SMI. The first stage of the research was applied with very few problems. Senior Management had already decided the SMI to be implemented before starting the use of the workbook, hence the prioritisation of the strategic manufacturing initiatives was not required. The first stage of the implementation effort started with the formalisation of the strategic benefits. This activity provided a lot of discussion among Senior Managers and the identification of potentially new opportunities that may be transformed into future strategic manufacturing initiatives. The strategic analysis is presented in Appendix F. Senior Managers agreed that the discussions were useful and that documenting and comparing the strategic manufacturing performance and market requirements proved to be of great value in terms of shared understanding between them, the project manager and project team members during the whole life of the project. The estimated financial benefits and duration were also documented following the methodology. At this stage of the methodology, Senior Managers included a list of key performance objectives, based on the strategic analysis, as the expected strategic output of the implementation. This activity seemed a bit redundant later on in the project as it was already defined in the strategic analysis.

Stage 2: Resources Planning and Management. The application of the second stage of the methodology proved to be more difficult. The selection of the Project Manager followed the workbook guidelines but it was not included in the project file as it was considered not appropriate to be shared with the rest of the project team and other manufacturing employees. Senior Management argued about the incentives sheets included in the workbook and considered that in this specific SMI there was no need for special incentives because the workforce was sufficiently motivated. The project manager chose the project team and also discarded the incentive sheet for the same reasons. The SMI Diagnosis and Scope was a total success. The project team meetings that addressed these activities were very useful and created the right mindset and level of understanding in all team members. The Project Team accepted the benefits proposed by senior management and they moved to the third stage of the implementation methodology.

Stage 3: Project Control. Two of the four steps of this stage were successfully followed: defining project milestones, using the Gantt chart; and determining and planning individual activities / responsibilities, using the How-How analysis. Most of the Project Team members and the Project Manager found the explanations of how to use and apply the tools and techniques easy to follow and useful. The other two steps, planning the quality control activities and cost control, were not found relevant to this SMI project. Quality control activities were embedded with the other project activities; consequently there was no need to create a second control chart that would separate them from the rest. This seemed quite logical and all the team members agreed. Cost control activities were not required because the implementation of the project did not involve any significant expense.

Stage 4: Manufacturing-wide Communication System. The fourth stage of the methodology was followed and a manufacturing-wide communication plan was successfully created and applied. The Project Team added at this stage of the workbook a Technical Documentation step as keeping and sharing the appropriate technical project records was found necessary. Many participants expressed that a training plan should also be included at this stage to ensure timely development and delivery of training programmes to the right individuals. The team also suggested that a more formalised Unintended Opportunities stage should be included in order to keep organised records of new ideas and to fix dates for review meetings with Senior Management that may capitalise on these new findings that could further develop internal manufacturing capabilities in the future.

Stage 5: Project Evaluation. The final stage of the methodology was successfully applied although the milestones and deliverables reviews were not documented. They took the shape of more informal meetings in contrast with the more formalised approach suggested in the workbook. This resulted in some confusing and wrong messages in the channels of communication between project manager and project team members which did not match completely the feedback given to the project manager by the senior management. The final project adherence review was successfully performed and a meeting was held between all the parties involved in order to learn from the experience.

9.5 Refinement to the SMI Implementation Methodology

This section presents the changes raised during the application of the methodology. The purpose of this stage is to use the feedback data gathered from the application of the methodology to identify, refine and improve the SMI implementation methodology. From the application, a number of areas for minor changes have been suggested by the participants. Most changes refer to the addition or deletion of some specific contents to some stages. Table 9.8 illustrates the main changes resulting from the application of the methodology. Some modifications to the titles of the stages were also required to reflect the changes made after the evaluation of the methodology (Chapter 8) and its application presented in this Chapter. The new titles for the stages are presented in Table 9.9.

	Main Changes to the SMI Implementation Methodology
1	A Technical Documentation stage has been added to Stage 4.
2	A Training Planning stage has been added to Stage 4.
3	A more detailed Unintended Opportunities stage has been added.
4	The need for formalised Milestones and Deliverables Reviews has been emphasised
5	The quality control activities have been embedded with the project implementation activities
6	The identification of Unintended Opportunities throughout the whole life of the implementation project has been explained in the Introductory section

Table 9.8: Main Changes to the SMI Implementation Methodology

STAGES (before)	STAGES (after)
Introduction	**Getting Started**
Define the Strategic Manufacturing Initiative	**Strategic / Financial Benefits and Duration**
Resources Planning and Management	**Resources and Assessments of Benefits and Duration**
Project Control	**Activities and Control**
Manufacturing-wide Communication System	**Communication and Training Plans**
Project Evaluation	**Reviews**

Table 9.9: Changes to Stages' Titles

9.6 Chapter Summary

The chapter has reported on the application of the SMI implementation methodology, aimed to determine its feasibility, usability and usefulness. This test was performed in a case study in the sponsor organisation, where practitioners followed the workbook methodology, and its tools and techniques, to guide the implementation of a strategic manufacturing initiative over a period of 2 months. A case study method has been adopted for this stage of the research.

The methodology was judged in terms of the company's reactions to the methodology and the observations of the researcher. Evaluation questionnaires were completed so that feedback from the participants could be analysed and changes to the methodology drawn. The researcher acted as an observer to the application of the methodology. It is not possible to generalise on the value of the methodology or to judge the degree to which it is effective after this particular study. However, the case study has clearly demonstrated that the methodology performed well against the criteria of feasibility, usability and usefulness. This second phase of testing confirmed the findings of the primary evaluation of the pilot methodology (Section 8.4), but also resulted in a number of modifications to the methodology. The final SMI implementation methodology is described in the next chapter.

Chapter 10: The Final Methodology for the Implementation of Strategic Manufacturing Initiatives

In Chapters 8 and 9 testing was carried out to evaluate and to validate the applicability of the SMI implementation methodology. As a result, a number of minor changes emerged. This chapter, namely the final methodology for the implementation of strategic manufacturing initiatives, starts by stating the objective and method, followed by an overview and description of the final SMI implementation methodology including the match of stages with the key success factors in the implementation of strategic manufacturing initiatives identified in Chapter 6.

10.1 Stage 6 Objective and Method

The objective of the sixth stage of the research programme is to present the final SMI implementation methodology. As Figure 10.1 illustrates, the final methodology has been formed and then checked by combining the following logical sources:

- Pilot methodology steps (Chapter 7)
- Feedback from the evaluation of the pilot methodology (Chapter 8)
- Refinement from the application (Chapter 9)
- Key success factors in the implementation of SMIs (Chapter 6)

These sources provide the required information to finalise the content, structure, and steps of the final methodology as shown in Figure 10.1. The structure of the final methodology is still based on a five-stage approach firstly introduced in the pilot methodology (Chapter 7). The outcome is the documented workbook shown in Appendix H. Having outlined the sources used to form the final methodology, the next section provides an overview and a description of the final SMI implementation methodology.

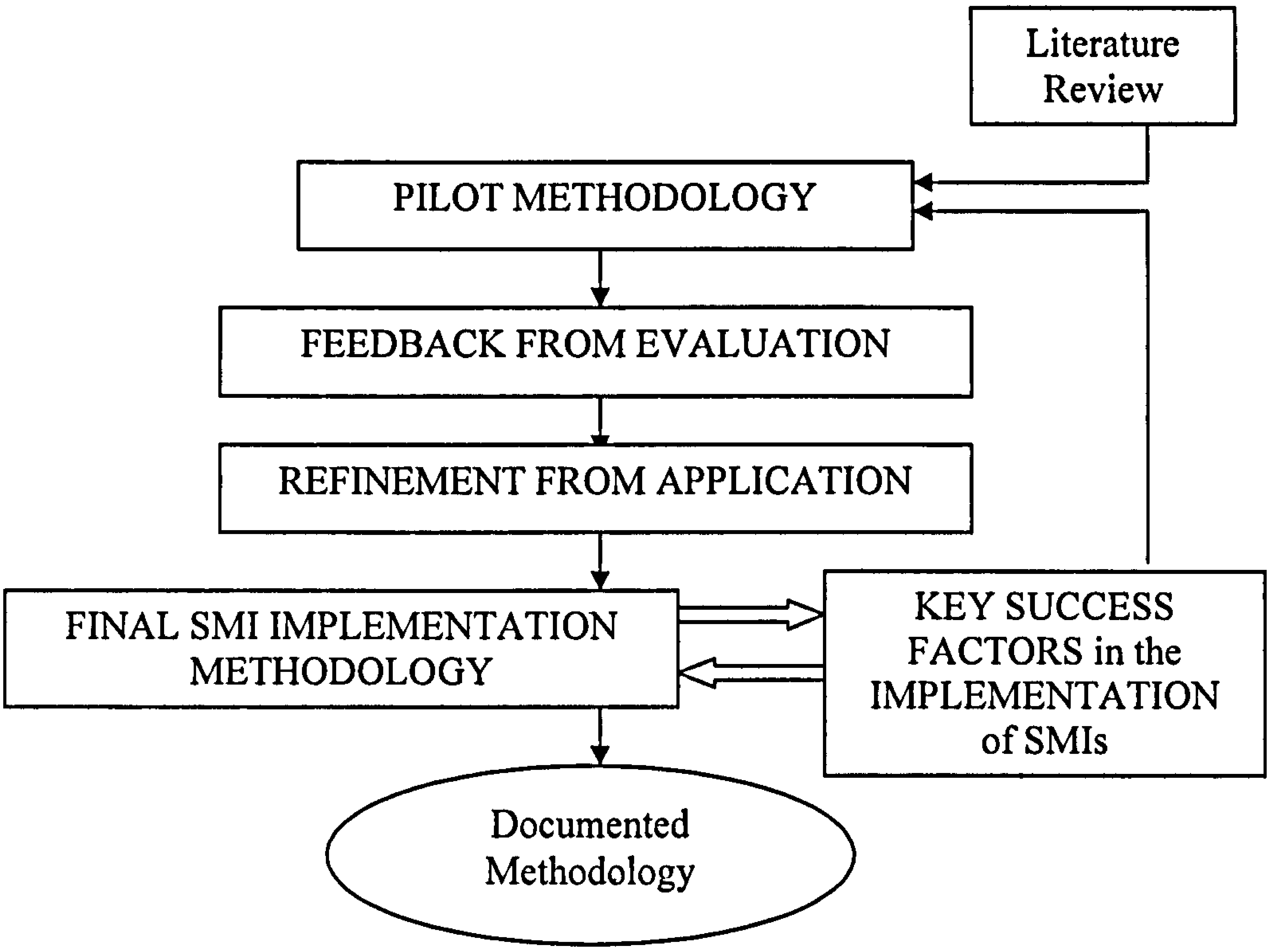

Figure 10.1: Phases Leading to the Final Methodology

10.2 The SMI Implementation Methodology

This section provides a detailed description of the methodology to illustrate the structure, the steps and their use when following the approach. Firstly, an overview of the methodology is provided. Secondly, a detailed description of each one of the stages in the methodology is presented.

10.2.1 Overview of SMI Implementation Methodology

This section is an overview of the SMI implementation methodology, the content, structure and its steps. As Figures 10.2 and 10.3 show, the SMI implementation methodology is a five-stage procedural approach that guides the actions of all the participants in a SMI implementation team.

The SMI implementation methodology provides a structured guide that will help practitioners to succeed in the implementation of Strategic Manufacturing Initiatives. In achieving this it helps the practitioner to:

- Prioritise Strategic Manufacturing Initiatives
- Formalise the Strategic Benefits, Financial Benefits and Duration of the Implementation project
- Select the Project Manager and Project Team Members and formalise their secondments and incentives
- Diagnose and Scope the Implementation Project agreeing Strategic/Financial Benefits, Special Resources and Duration of the project
- Define Milestones, Implementation Activities and Quality Control Activities
- Develop an Activity Plan and Time/Cost Control system
- Design Communication and Training plans and compile Technical Documentation
- Review the success of the project and the process of SMI implementation

Stage	Title
1	Strategic / Financial Benefits and Duration

Inputs	Outputs
- Set of SMIs - SMIs Strategic Benefits, Financial Benefits and estimated Duration	- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and Duration

Stage	Title
1.1	Prioritise SMIs

Inputs	Outputs
- Set of SMIs - SMIs Strategic Benefits, Financial Benefits	- Selected SMI to be implemented

Stage	Title
1.2	Document Strategic Benefits

Inputs	Outputs
- Selected SMI to be implemented - SMI Strategic Benefits	- Documented SMI Strategic Benefits

Stage	Title
1.3	Document Financial Benefits and Duration

Inputs	Outputs
- Selected SMI to be implemented - SMI Financial Benefits and estimated Duration	- Documented SMI Financial Benefits and Duration

Stage	Title
2	Resources and Assessments of Benefits & Duration

Inputs	Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration	- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets

Stage	Title
2.1	Select Project Manager and formalise incentives

Inputs	Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration	- Project Manager

Stage	Title
2.2	Select Project Team members and formalise incentives

Inputs	Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration	- Project Team

Stage	Title
2.3	Diagnose SMI and identify Special Resources

Inputs	Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration	- SMI Diagnosis and Special Resources

Stage	Title
2.4	Scope SMI (agreement of benefits and duration)

Inputs	Outputs
- Selected SMI to be implemented - SMI Diagnosis	- SMI Scope and agreement of targets

Figure 10.2: Stages 1 and 2 of the SMI Implementation Methodology

Stage	Title
3	Activities and Control
Inputs	**Outputs**
- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control

Stage	Title
3.1	Formalise Milestones
Inputs	**Outputs**
- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Milestones

Stage	Title
3.2	Define Activities and allocate responsibilities
Inputs	**Outputs**
- SMI Milestones - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Activities

Stage	Title
3.3	Activity Planning and Time Control
Inputs	**Outputs**
- SMI Scope and agreement of targets - SMI Milestones - SMI Activities	- SMI Time Control

Stage	Title
3.4	Cost Control
Inputs	**Outputs**
- Special Resources - SMI Scope and agreement of targets - SMI Time Control	- SMI Cost Control

Stage	Title
4	Communication and Training Plans
Inputs	**Outputs**
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control	- SMI Communication Plan - SMI Training Plan - SMI Technical Documentation

Stage	Title
4.1	Communication Plan
Inputs	**Outputs**
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control	- SMI Communication Plan

Stage	Title
4.2	Training Plan
Inputs	**Outputs**
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control	- SMI Training Plan

Stage	Title
4.3	Technical Documentation
Inputs	**Outputs**
- SMI Milestones and SMI Activities	- SMI Technical Documentation

Stage	Title
5	Reviews
Inputs	**Outputs**
- Outputs from all the Stages	- Milestones Review - Implementation Process Review

Stage	Title
5.1	Deliverables Review
Inputs	**Outputs**
- Outputs from all Stages	- SMI Milestones Reviews - SMI Benefits Review

Stage	Title
5.2	Implementation Process Review
Inputs	**Outputs**
- Outputs from all Stages	- SMI Implementation Process Review

Figure 10.3: Stages 3, 4 and 5 of the SMI Implementation Methodology

The SMI implementation workbook is intended as a guide to the management of the implementation of Strategic Manufacturing Initiatives (SMI). It sets out in a series of stages the main steps in this process. The intention is to provide a generic methodology that will help to ensure that the implementation of SMIs are rigorous and successful. However, the workbook does not replace procedures, experience, nor provide a fool proof method. It is an aid that could and should enhance the process of SMI implementation. The workbook can be used in two ways. Firstly, to act as a step by step methodology for Senior Management, Project Managers and Project Teams involved in the implementation of SMIs, by providing guidelines, tools and techniques to assist in the management of the project. Secondly, it provides an overall view of the activities involved in SMI implementation projects, for those who wish to quickly familiarise themselves with this process.

Prior to the start of the implementation process described in the methodology, a manufacturing strategy must be formulated and a set of potential strategic manufacturing initiatives and their correspondent business cases must be carried out. Each stage in the SMI implementation process is described in the workbook. Usually stages have been broken down into two or more steps (Figures 10.2 and 10.3). In creating the workbook, a balance has been sought between providing sufficient guidance for an activity, but without introducing so much detail that the user becomes bogged down and frustrated. The complete description for each stage is presented in just one page, which should aid usability. Each stage in the SMI implementation process is described in terms of Stage number, Title, Inputs, Outputs, Objective and Steps.

There are a total of five roles identified as part of the SMI implementation methodology. The responsibilities of each one of these stakeholders are described in each stage of the methodology. Table 10.1 presents the definition of each one of the roles. Table 10.2 illustrates the responsibilities of stakeholders against each one of the methodology stages.

ROLE	DESCRIPTION
Senior Management	Level of management that have the capability to launch Strategic Manufacturing Initiatives, and influence and decide strategic decisions providing a high degree of support to strategic projects
Project Manager	People that drive, own and facilitate the methodology of Strategic Manufacturing Initiative implementation
Project Team Members	People who perform the implementation activities of the project, probably internal to the organisation
Project Team	The Project Manager and Project Team Members
Manufacturing employees	People internal to the organisation who are affected by the Strategic Manufacturing Initiatiave but are not directly involved in its implementation

Table 10.1: Descriptions of Roles in the SMI Implementation Methodology

Stages			Responsibilities
Stage 1 Strategic / Financial Benefits and Duration	**1.1**	Prioritise SMIs	Senior Management
	1.2	Document Strategic Benefits	Senior Management
	1.3	Document Financial Benefits and Duration	Senior Management
Stage 2 Resources and Assessments of Benefits and Duration	**2.1**	Select Project Manager and formalise incentives	Senior Management
	2.2	Select Project Team Members and formalise incentives	Project Manager
	2.3	Diagnose SMI and identify Special Resources	Project Team
	2.4	Scope SMI (agreement of benefits and duration)	Project Team / Senior Management
Stage 3 Activities and Control	**3.1**	Formalise Milestones	Project Team
	3.2	Define Activities and allocate responsibilities	Project Team
	3.3	Activity Planning and Time Control	Project Team
	3.4	Cost control	Project Team
Stage 4 Communication and Training Plans	**4.1**	Communication Plan	Project Team
	4.2	Training Plan	Project Team
	4.3	Technical Documentation	Project Team
Stage 5 Reviews	**5.1**	Deliverables Review	Project Manager / Senior Management
	5.2	Implementation Process Review	All

Table 10.2: Stage Responsibilities in the SMI Implementation Methodology

Table 10.3 shows the tools and techniques included in the final SMI implementation methodology after its evaluation (Chapter 8) and its application in industry settings (Chapter 9).

STAGE	TOOLS & TECHNIQUES
Getting Started	Strategic principles; Organisational theory; Flowchart; Stakeholder analysis
Strategic/Financial Benefits and Duration	Strategic analysis; Project (SMI) selection and prioritisation method; Business case
Resources and Assessments of Benefits and Duration	Selection method; Reward and recognition system; Fishbone analysis; Wishbone analysis; Estimating tools
Activities and Control	Work breakdown structure; Gantt chart; Quantitatively based durations; How-how analysis; Quality control tool; Cost control tool; Precedence diagramming
Communication and Training Plans	Communication planning tool; Training planning tool; Information distribution tool
Reviews	Performance reporting tool; Process Quality Performance measurement tool

Table 10.3: Tools and Techniques included in each Stage of the Methodology

In order to develop a methodology that would successfully guide practitioners in the implementation of SMIs, we have focused on those tasks and activities that must be done well in order to achieve success. Stage 2 of the research programme (Chapter 6) identified the key success factors in the implementation of strategic manufacturing initiatives in practice. The pilot methodology for the implementation of SMIs was then formed based on this assessment and a review of project management methodologies in literature. The SMI implementation methodology has been refined after evaluation (Chapter 8) and application in industry settings (Chapter 9). The ultimate step in the development of the final SMI implementation methodology was to ensure that the methodology addresses and is properly aligned with the key success factors identified. Tables 10.4 to 10.8 illustrate this analysis.

Stage 1: Strategic / Financial Benefits and Duration		
Order	KEY SUCCESS FACTORS ADDRESSED	
1	PROJECT MANAGER	Communication: Project manager is able to listen, understand, and communicate accurately and constantly
2	TOP/SENIOR MANAGEMENT	Committed to project scope
8	SOCIAL & EXTERNAL INFLUENCES	Project creates a feeling of needed change for the better, change for the future
9	TOP/SENIOR MANAGEMENT	Good knowledge and understanding of business and manufacturing strategies and strategic goals
15	TOP/SENIOR MANAGEMENT	Involved in strategy formulation
16	STRATEGIC LINK & COMPANY WIDE	There is a limited number of projects being implemented in manufacturing at any one time in order to provide focus and prioritise resources
27	STRATEGIC LINK & COMPANY WIDE	Keep project (or project stage duration) as far below 3 years as possible (1 year is better)
33	STRATEGIC LINK & COMPANY WIDE	A sense of urgency is maintained during the life of the project
34	TOP/SENIOR MANAGEMENT	Enthusiasm, positive attitude, creative thinking
35	STRATEGIC LINK & COMPANY WIDE	The organisation engages in excellent project management including clear scope definition, resource planning, project progress tracking system, and business processes change management.

Table 10.4: Key Success Factors addressed by Stage 1 of the Methodology

Stage 2: Resources and Assessments of Benefits and Duration		
Order	KEY SUCCESS FACTORS ADDRESSED	
2	TOP/SENIOR MANAGEMENT	Committed to project scope
3	PROJECT TEAM MEMBERS	Project evaluation measures are very clear to team members and included from the beginning
4	PROJECT MANAGER	Committed to project scope
5	PROJECT TEAM MEMBERS	Motivated
6	STRATEGIC LINK & COMPANY WIDE	Sufficient resources are at the disposal of the project manager/team
7	PROJECT MANAGER	Enthusiasm, positive attitude, creative thinking
9	TOP/SENIOR MANAGEMENT	Good knowledge and understanding of business and manufacturing strategies and strategic goals
10	PROJECT MANAGER	Strong goal orientation
13	PROJECT MANAGER	Ability to see the project as a whole
14	TOP/SENIOR MANAGEMENT	Provides full, active and clearly visible support to the project during its whole life
15	TOP/SENIOR MANAGEMENT	Involved in strategy formulation
16	STRATEGIC LINK & COMPANY WIDE	There is a limited number of projects being implemented in manufacturing at any one time in order to provide focus and prioritise resources
18	STRATEGIC LINK & COMPANY WIDE	All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales)
19	PROJECT TEAM MEMBERS	Enthusiasm, positive attitude, creative thinking
20	PROJECT MANAGER	Good knowledge and understanding of business and manufacturing strategies and strategic goals
21	PROJECT MANAGER	Planning skills
24	PROJECT MANAGER	Coping with situations: Project manager is flexible, patient, and persistent
25	PROJECT TEAM MEMBERS	Committed to project scope
26	PROJECT TEAM MEMBERS	Multifunctional members from different departments
27	STRATEGIC LINK & COMPANY WIDE	Keep project (or project stage duration) as far below 3 years as possible (1 year is better)
28	PROJECT MANAGER	The same Project Manager stays during the whole duration of the strategic implementation
29	PROJECT TEAM MEMBERS	Changes in responsibilities are clearly defined and understood
31	PROJECT MANAGER	Project manager is able to release the energies of his subordinates, project team members, ...
32	PROJECT MANAGER	Delegating Authority: Project manager is able to give people the opportunity as group members to participate in making decisions
35	STRATEGIC LINK & COMPANY WIDE	The organisation engages in excellent project management including clear scope definition, resource planning, project progress tracking system, and business processes change management.
36	PROJECT MANAGEMENT PROCESSES	Project Cost Management

Table 10.5: Key Success Factors addressed by Stage 2 of the Methodology

Stage 3: Activities and Control		
Order	KEY SUCCESS FACTORS ADDRESSED	
3	PROJECT TEAM MEMBERS	Project evaluation measures are very clear to team members and included from the beginning
5	PROJECT TEAM MEMBERS	Motivated
6	STRATEGIC LINK & COMPANY WIDE	Sufficient resources are at the disposal of the project manager/team
10	PROJECT MANAGER	Strong goal orientation
11	STRATEGIC LINK & COMPANY WIDE	Key implementation tasks and milestones are sufficiently defined
12	PROJECT MANAGEMENT PROCESSES	Project Quality Management
13	PROJECT MANAGER	Ability to see the project as a whole
17	PROJECT MANAGER	Organizing skills
18	STRATEGIC LINK & COMPANY WIDE	All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales)
20	PROJECT MANAGER	Good knowledge and understanding of business and manufacturing strategies and strategic goals
21	PROJECT MANAGER	Planning skills
29	PROJECT TEAM MEMBERS	Changes in responsibilities are clearly defined and understood
30	PROJECT MANAGEMENT PROCESSES	Project Time Management
32	PROJECT MANAGER	Delegating Authority: Project manager is able to give people the opportunity as group members to participate in making decisions
36	PROJECT MANAGEMENT PROCESSES	Project Cost Management

Table 10.6: Key Success Factors addressed by Stage 3 of the Methodology

Stage 4: Communication and Training Plans		
Order	KEY SUCCESS FACTORS ADDRESSED	
1	PROJECT MANAGER	Communication: Project manager is able to listen, understand, and communicate accurately and constantly
4	PROJECT MANAGER	Committed to project scope
8	SOCIAL & EXTERNAL INFLUENCES	Project creates a feeling of needed change for the better, change for the future
11	STRATEGIC LINK & COMPANY WIDE	Key implementation tasks and milestones are sufficiently defined
14	TOP/SENIOR MANAGEMENT	Provides full, active and clearly visible support to the project during its whole life
17	PROJECT MANAGER	Organizing skills
18	STRATEGIC LINK & COMPANY WIDE	All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales)
20	PROJECT MANAGER	Good knowledge and understanding of business and manufacturing strategies and strategic goals
21	PROJECT MANAGER	Planning skills
22	MANUFACTURING EMPLOYEES	Awareness of the project
23	MANUFACTURING EMPLOYEES	Trained in how to work with the new practice/system/application/technology, the outcome and its advantages
25	PROJECT TEAM MEMBERS	Committed to project scope
30	PROJECT MANAGEMENT PROCESSES	Project Time Management
31	PROJECT MANAGER	Project manager is able to release the energies of his subordinates, project team members, ...
32	PROJECT MANAGER	Delegating Authority: Project manager is able to give people the opportunity as group members to participate in making decisions

Table 10.7: Key Success Factors addressed by Stage 4 of the Methodology

Stage 5: Reviews		
Order	KEY SUCCESS FACTORS ADDRESSED	
2	TOP/SENIOR MANAGEMENT	Committed to project scope
6	STRATEGIC LINK & COMPANY WIDE	Sufficient resources are at the disposal of the project manager/team
9	TOP/SENIOR MANAGEMENT	Good knowledge and understanding of business and manufacturing strategies and strategic goals
10	PROJECT MANAGER	Strong goal orientation
11	STRATEGIC LINK & COMPANY WIDE	Key implementation tasks and milestones are sufficiently defined
13	PROJECT MANAGER	Ability to see the project as a whole
14	TOP/SENIOR MANAGEMENT	Provides full, active and clearly visible support to the project during its whole life
15	TOP/SENIOR MANAGEMENT	Involved in strategy formulation
17	PROJECT MANAGER	Organizing skills
18	STRATEGIC LINK & COMPANY WIDE	All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales)
20	PROJECT MANAGER	Good knowledge and understanding of business and manufacturing strategies and strategic goals
21	PROJECT MANAGER	Planning skills
24	PROJECT MANAGER	Coping with situations: Project manager is flexible, patient, and persistent
28	PROJECT MANAGER	The same Project Manager stays during the whole duration of the strategic implementation
30	PROJECT MANAGEMENT PROCESSES	Project Time Management
33	STRATEGIC LINK & COMPANY WIDE	A sense of urgency is maintained during the life of the project
34	TOP/SENIOR MANAGEMENT	Enthusiasm, positive attitude, creative thinking
35	STRATEGIC LINK & COMPANY WIDE	The organisation engages in excellent project management including clear scope definition, resource planning, project progress tracking system, and business processes change management.

Table 10.8: Key Success Factors addressed by Stage 5 of the Methodology

10.2.2 Stage 1: Strategic / Financial Benefits and Duration

Before embarking on the implementation of a Strategic Manufacturing Initiative (SMI), the organisation must have formulated its manufacturing strategy. The key outcome of this formulation process will be a set of SMIs and the related business cases, strategic link analyses and estimated durations. It must be noted at this stage that SMIs may also be identified by different members of the organisation during the implementation process of other Strategic Manufacturing Initiatives (Stage 4.1, Step 5).

On completion of this stage, a specific SMI will be selected for implementation and its strategic and financial benefits and estimated duration will be documented for inclusion in the formalised project documentation. This is in order to achieve common strategic understanding and better strategic decision making at all levels including Senior Management, Project Manager, Project Team Members and other manufacturing employees. To realise stage 1 of the methodology, the following stages will be carried out:

Stage 1.1 Prioritise SMIs. The objective of Stage 1.1 is to select the SMI to be implemented. The intention is to avoid the manufacturing organisation taking on too many Strategic Manufacturing Initiatives resulting in overstretched financial resources and diluting attention away from really important projects. In performing this stage, we will avoid marginal projects being undertaken whereas the comparatively more attractive are left behind.

Stage 1.2 Document Strategic Benefits. The objective of Stage 1.2 is to document the Strategic Benefits of the selected Strategic Manufacturing Initiative to be implemented. The intention is to ensure that everyone involved or affected by the SMI is aware of its strategic benefits. Therefore everyone would be able to make better decisions during the different stages of the SMI implementation project aiming to achieve the strategic benefits set out.

Stage 1.3 Document Financial Benefits and Duration. The objective of Stage 1.3 is to document the Financial Benefits and the estimated Duration of the selected Strategic Manufacturing Initiative to be implemented. The intention is to ensure that everyone involved or affected by the SMI is aware of its financial benefits and projected timescale. Therefore everyone would be able to make better decisions during the different stages of the SMI implementation project aiming to achieve the financial benefits and duration set out.

10.2.3 Stage 2: Resources and Assessments of Benefits and Durations

Allocation and management of resources is a fundamental requirement for effective SMI implementation project planning and management. One of the most critical factors is the selection of the Project Manager and the Project Team members. The objectives of this stage are to select the most appropriate human resources for the implementation project and to formalise their incentives to succeed, diagnose the SMI, and identify special resources required. Finally the Project Team accepts or amends the initial targets set out by Senior Management. To realise this stage, the following stages will be carried out:

Stage 2.1 Select Project Manager and formalise incentives. The objective of Stage 2.1 is that Senior Management recruits and provides the right incentives to the most appropriate Project Manager who possesses the necessary personal qualities to positively influence the ultimate success of the SMI implementation project. The success of the SMI implementation project is very much dependant on the Project Manager in charge of it. In order to increase the chances for success, the same Project Manager must remain for the whole duration of the strategic implementation and should be trained in the use of this workbook.

Stage 2.2 Select Project Team Members and formalise incentives. The objective of this stage is that the Project Manager recruits and provides the right incentives to Project Team members and once agreed with Senior Management, changes in responsibilities from previous functional responsibilities are clearly communicated to them, and fully supported by their functional managers. If needed, Project Team members should be trained to carry out specific tasks and they should also be trained in the use of this workbook.

Stage 2.3 Diagnose SMI and identify Special Resources. The objective of Stage 2.3 is that the Project Team performs an initial analysis of the project that they are facing. The Project Team will diagnose the key issues of the SMI including why the current practice is the way it is or why current problems exist (using Fishbone analysis), and looking at the ways in which factors and conditions are required to change to fulfil the SMI as a new manufacturing practice (using Wishbone analysis). Special machine or organisational resources required must be identified by the Project Manager and Project Team Members at this Diagnosis stage of the implementation project and they must be discussed, agreed and provided by Senior Management. Other Special Resource needs generated during the implementation process will have to be won in competition with other projects and day-to-day operation.

Stage 2.4 Scope SMI (agreement of benefits and duration). The objective of Stage 2.4 is that the Project Team and Senior Management agree the project objectives, duration and initial special resources identified. The outcomes of this stage provide a clear and shared understanding of the project evaluation measures.

10.2.4 Stage 3: Activities and Control

The objectives of Stage 3 is to plan and control the evolution of the project in terms of time, cost and quality planning of the SMI implementation. This will involve defining project milestones, determining and planning the individual activities, estimating and controlling project costs, and planning and assuring the quality process. The planning and control processes are needed to achieve the strategic and financial objectives of the project as well as the agreed duration of the implementation. To realise this stage, the following stages will be carried out:

Stage 3.1 Formalise Milestones. The objective of Stage 3.1 is that the Project Team define and document the SMI implementation Milestones. A project milestone is a key project deliverable or key indicator of progress and the time by which it is going to be achieved. Project milestones are used by the Project Manager as stages in the development of the project and by the Project Team to further detail specific project activities. They are also used by the Senior Management in project reviews.

Stage 3.2 Define Activities and allocate responsibilities. The objective of Stage 3.2 is that the Project Team define and document the SMI implementation Activities using the How-How technique. The project activities are those tasks that must be performed to produce the Milestones identified. Implicit to this stage is the need to define the activities such that the project benefits will be met.

Stage 3.3 Activity planning and time control. The objective of Stage 3.3 is that the Project Team phase Project Activities over time using a Gantt Chart. The project activities should be scheduled so that the total SMI Duration is within the terms agreed with Senior Management (SMI Scope).

Stage 3.4 Cost control. The objective of Stage 3.4 is that the Project Team controls the costs of the project over time in order to ensure that the SMI implementation is completed within the agreed financial analysis.

10.2.5 Stage 4: Communication and Training Plans

The objectives of Stage 4 are to develop a Project Communication strategy, to plan the manufacturing-wide Training needs for the successful implementation of the SMI, and to compile all the technical documentation relevant to the implementation effort. Everyone involved in the project including the Project Manager, Project Team Members and Senior Management must understand how the communications of the strategic project in the manufacturing organisation are going to be carried out and the accountability for these communications. The role of Senior Management in communication is critical. Senior Management must provide full, active and clearly visible support to the project during its whole life. To realise this stage, the following stages will be carried out:

Stage 4.1 Communication Plan. The objective of Stage 4.1 is to develop a plan to ensure timely and appropriate generation and dissemination of project information relevant to Senior Management and manufacturing employees. The Communication Plan will define the information and communication needs of Senior Management and manufacturing employees: who needs what information, when they will need it, how it will be given to them, and who is responsible to prepare and deliver this information.

Stage 4.2 Training Plan. The objective of Stage 4.2 is to develop a plan to ensure timely and appropriate identification, generation and dissemination of training needs relevant to everyone in the manufacturing organisation affected by the implementation of the SMI. The Training Plan will define the training needs that are required for the successful implementation of the SMI: who needs what training, when they will need it, how it will be delivered to them, and who is responsible to prepare and deliver it. Manufacturing employees and potentially Project Team Members and Senior Management will have to be trained in how to work with the new practice, system, application or technology resulting from the implementation of the SMI.

Stage 4.3 Technical Documentation. The objective of Stage 4.3 is to make all necessary documentation available to project team members, the project manager, senior management and other manufacturing employees in an organised manner. Project documentation may include correspondence, memos, work results, procedures, and other technical documentation. This information should, to the extent possible and appropriate, be maintained in an organised fashion. Project team members and the project manager may often maintain personal records in a project notebook.

10.2.6 Stage 5: Reviews

The objectives of Stage 5 are to plan the Senior Management Reviews of the Project Milestones, Project Success after completion and the Project's adherence to the

Implementation Process. Finally, changes to the Implementation Process will be made. To realise this stage, the following sections will be carried out:

Stage 5.1 Deliverables Review. The objective of Stage 5.1 is that Senior Management reviews the Milestones of the Project and feedbacks the Project Team in their progress.

Stage 5.2 Implementation Process Review. The objective of Stage 5.2 is to evaluate, once the project has been completed, the Senior Management, Project Manager and Project Team's adherence to the formalised implementation process presented in the workbook and to learn from experience in order to further enhance the methodology and adapt it to the specific culture or manufacturing environment in which it is used if necessary.

10.3 Chapter Summary

This chapter has presented the final SMI implementation methodology. It provides a holistic view of the stages, steps, activities and their alignment with the key success factors in the implementation of SMIs identified in Chapter 6. The methodology is structured, procedural and descriptive, and focuses on how to carry out the implementation of a strategic manufacturing initiative effectively from the start to the end. The next chapter will conclude the research programme, make contribution to knowledge and recommend further research in the field.

Chapter 11: Conclusions

This research set out to create a methodology that would guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives. This chapter summarises the research findings against the research aim and discusses contributions to knowledge. The limitations of the research are indicated, directions for future work suggested, and finally, concluding remarks given.

11.1 Overview of Research Aim and Programme

This section provides an overview of the research aim and programme. The research aim of this work was as follows:

> "*to develop a methodology to guide practitioners in the successful and rigorous implementation of strategic manufacturing initiatives.*"

The research aim was addressed by completing a set of objectives, namely to:

1. Review existing literature on methodologies for the implementation of SMIs.
2. Identify critical success factors in the practical implementation of SMIs in industry.
3. Develop a method for SMI implementation.
4. Evaluate and refine the methodology through practitioners' assessment and practical application in industry settings.

The research described in this thesis has set out to create a SMI implementation methodology through a structured research programme. Initially existing literature related to SMI implementation methods was reviewed and analysed. A pilot methodology was then formed by contrasting literature against a list of key success factors in the implementation of strategic manufacturing initiatives determined from a worldwide survey to gather practitioners' judgement. The pilot methodology was evaluated by a selection of practitioners, and results were used to refine the methodology. Finally, an application test was conducted in the sponsor company allowing the organisation to use the methodology and provide feedback with the researcher acting as an observer.

11.2 Research Findings

The following summarises the findings from the main stages of the research programme, together with findings relating to issues collated from the different studies.

11.2.1 Determination of the 36 Key Success Factors in the Implementation of Strategic Manufacturing Initiatives

The second stage of this research resulted in the identification of those tasks and activities that must be done well in order to succeed in the implementation of a SMI in practice. A respondent based information generation research method was chosen. The research design consisted of five stages: definition of research categories and literature search to identify potential key success factors; design and validation of the questionnaire; selection of manufacturing organisations; execution of survey; and finally analysis of the results.

The choice of factors provided in the questionnaire for practitioner's evaluation of their criticality was formed based on selected studies already reporting their importance in different contexts or fields. This study has then provided the degree and order of criticality of these factors in the strategic manufacturing implementation area. Additionally, in order to identify a widely applicable list of key success factors, we have defined a KSF as that factor that has received a top 20% criticality score (i.e. scores of 8 or 9) by more than 50% of the respondents. The list of the 36 key success factors is illustrated in Table 6.2. From the analysis of these factors, the following findings are drawn:

1. Project Manager's individual qualities and skills is the most critical factor for the success of the implementation of a Strategic Manufacturing Initiative.

2. The success of project management in the strategic manufacturing field is very much dependent on the human side of a project.
3. Organisations facing the successful accomplishment of a Strategic Manufacturing Initiative must focus their efforts in ensuring the availability of resources and convincing employees of the criticality of the initiative.
4. Project Management critically contributes to the success of the implementation of SMIs.
5. A successful Project Management methodology for the implementation of Strategic Manufacturing Initiatives would emphasise the use of Project Quality, Cost and Time Management processes

11.2.2 Review of Existing Project Management Methodologies against the Key Success Factors Identified

Current methods have been identified, collated and compared against the set of key success factors resulting from our study based. This assessment has been conducted based on an adaptation of Avison and Fitgerald's (1995) framework, focusing of seven comparison components: philosophy, model, structure, outputs, tools and techniques, practice, and product. The results suggest that even though there are comprehensive methodologies available, their level of relevance to the implementation of strategic manufacturing initiatives is low. The following findings are drawn:

1. The project management methodologies in literature are either intended to be useful for most projects or specific to a particular field not relevant to the implementation of SMIs. Contrarily, a SMI implementation methodology should draw attention to the most critical aspects specific to the strategic manufacturing implementation area.
2. Most methods in literature are not rigorous in terms of not being structured in a step-by-step fashion but in sections covering specific areas, concepts and principles of the project management discipline. A rigorous SMI implementation methodology should be a step-by-step methodology that would guide practitioners in the rigorous implementation of SMIs.

3. The outputs from most methods in literature are not based on the specific key success factors in the implementation of strategic manufacturing initiatives determined.
4. The tools and techniques employed by most methods in literature do not provide a suitable support for the implementation of SMIs because stages do not relate to the key success factors determined.
5. Practitioners either experienced or new to the implementation of SMIs would find it difficult to adhere to the sequence of stages determined by most methods in literature as they do not relate directly to the implementation of SMIs.

11.2.3 Formation of a Methodology that provides a Rigorous Process for the Successful Implementation of Strategic Manufacturing Initiatives

The relevant parts from the existing project management methodologies (Chapter 5) were extracted according to the critical factors in the strategic manufacturing area identified (Chapter 6), and based on a seven category analysis and comparison system (i.e. philosophy, model, structure, outputs, tools and techniques, practice, and product), a new pilot methodology was formed (Chapter 7). The SMI implementation methodology adopted a rigorous structured approach offering practitioners a set of step-by-step guidelines. The rigorous approach assists practitioners to follow the implementation process.

The SMI implementation methodology was evaluated by practitioners (Chapter 8) and then applied and tested in industry settings (Chapter 9) against the criteria of feasibility, usability and usefulness. The approach was found to successfully and rigorously capture the implementation of strategic manufacturing initiatives in terms of process and content. This satisfies the research design. A number of specific points that the assessment criteria indicate are presented below:

Feasibility

The SMI implementation methodology proved feasible:

- It was successfully evaluated by a selection of practitioners that showed their positive opinions with regard to the feasibility of the methodology. The sequence of stages was found to be correct and the steps in every stage of the workbook were found to be clear and well defined (Section 8.4).
- A manufacturing company successfully applied the methodology with the researcher acting as an observer (Chapter 9). Practitioners rated the feasibility of the methodology as 72% (Section 9.4.1).

Usability

- The workbook was found easy to follow by the selection of practitioners that conducted its primary evaluation (Section 8.4).
- The application was conducted with the refined version of the SMI implementation methodology (Chapter 9). The results were positive and showed that the usability of the methodology was rated as 75% (Section 9.4.2).

Usefulness

The methodology was considered useful across the primary evaluations and the case study application:

- All the primary evaluations concluded that the rigorous step-by-step workbook presented would benefit the whole implementation process. Practitioners argued that the application of the methodology would strongly contribute to the rates of success of SMI implementation projects.
- The overall feedback from the application of the methodology on its usefulness was positive; on the whole 61% was recorded (Section 9.4.3). On the point of whether they will use the methodology again in the future, 8 out of the 10 participants expressed their positive intentions of applying the methodology to guide future SMI implementation efforts with no, or minor, modifications (Section 9.4.3). This response proves that the methodology has been perceived as useful by practitioners.

This section has provided an overview of the research aim and programme, and it has summarised the findings of the research programme. The objectives of the research have been met. The major contributions of this thesis are now presented below.

11.3 Contribution to Knowledge of the Implementation of Strategic Manufacturing Initiatives

The research presented in this thesis makes two main contributions to knowledge on the subject of implementing strategic manufacturing initiatives. This section summarises both the primary and secondary contributions of this research.

11.3.1 Primary Contribution

The research showed that, although there are numerous project management methodologies in literature, there is little research about how to rigorously and successfully use such methodologies to implement strategic manufacturing initiatives. The use of an inappropriate methodology could result in overall project failure. The lack of a rigorous SMI implementation methodology specific to the strategic manufacturing area may cause practitioners to differ in their understanding of fundamental terms and their view on the sequence of stages, responsibilities, and tools and techniques behind the implementation of a strategic manufacturing initiative.

The main outcome of this research is the creation of a methodology to provide practical and procedural aid for SMI implementation efforts. The purpose of the methodology developed in this thesis is to guide the practitioner through a series of well-defined steps necessary to succeed in the implementation of a strategic manufacturing initiative. This rigorous structured approach to succeed in the implementation of strategic manufacturing initiatives forms the principal research contribution of this thesis. The initial aim of the research has been achieved.

11.3.2 Secondary Contribution

The other contribution is new knowledge on degree and order of criticality of key success factors when implementing strategic manufacturing initiatives. This research resulted in the identification of those tasks and activities that must be done well in order to succeed in the implementation of a SMI in practice. Key success factors can be thought of as the tasks or attributes that should receive priority attention because they strongly drive performance in the implementation of SMIs. The literature does not provide these critical factors. This research sought practitioners' judgement to identify the most critical aspects that positively influence the successful implementation of strategic manufacturing initiatives. The nature of this research meant that a questionnaire-based survey of practitioners worldwide was selected as the most appropriate research method. A structured research programme was adopted to achieve this objective: firstly, the research method and the selection of participants; secondly, the design, content and pre-test of the research method; thirdly, the analysis of results; and finally, a discussion of the key success factors and others findings from the study.

The major contributions of this research have been discussed. In the next section, the weaknesses identified within the research are discussed.

11.4 Limitations of the Research

The nature of the design and implementation of the research programme gives rise to some limitations that could affect the findings of this research.

11.4.1 Limitations of the Research set out to Identify Key Success Factors

The main limitation is that the research design, the selection of research categories, the literature review and the content of the questionnaire performed in this study have been influenced by a project management approach identified in the background of our research. This may have resulted in limiting the respondents' choice and structure of factors for scoring. Further research could test the validity of the findings of this research by seeking practitioners' judgement using a different research method and a different research design.

A second limitation identified in the research was the selection of organisations. The degree of influence of the existence of a corporation that owns all the companies in our study has been considered. Based on the independence in which the companies perform their diverse operational activities it has been concluded that the results presented should be applicable to other manufacturing organisations. Future studies using a different sample of companies will have to be carried out in order to confirm the universality of our results.

Thirdly, it could be argued that due to the wide variety of manufacturing organisations from different industries included in our study, the key success factors identified may not always be applicable to a specific manufacturing sector. Future research should study individual manufacturing sectors in order to report any alterations in the order of criticality of the factors.

11.4.2 Limitations of Primary and Secondary Evaluations of the Methodology

The main limitation is the limited number of methodology evaluation and application cases conducted within the time frame. The researcher would have preferred to have conducted a greater number of evaluation and case studies; however, this was not possible within the timescale of the project. In the evaluation studies conducted, the sample included a diversity of backgrounds of practitioners and companies. This mixture provided a means to an evaluation from diverse previous experiences and practices in different industry settings and contexts. The sole application case study was conducted in the sponsor company.

The second limitation identified was the use of the sponsor company to conduct the methodology application case study because they may be biased due to their willingness to prove the method successful. The research tried to overcome this situation by ensuring confidential judgement from a wide range of individuals, not only senior managers.

11.5 Directions for Further Research

Not all questions can be covered in a research project. Yet in the course of addressing the research aim and objectives, others arise which expose areas that require further investigation. This section examines such areas that require future research.

Three future research initiatives have been identified in the discussions of the limitations of the research set out to identify key success factors (Section 11.3.1). Firstly, future research could test the validity of the findings of this research by seeking practitioners' judgement using a different research method and a different research design. Secondly, future studies could use a different sample of companies in order to confirm the universality of our results. Thirdly, future research could study individual manufacturing sectors in order to report any alterations in the order of criticality of the factors.

Future research could address the integration of manufacturing strategy implementation and formulation. The objective of integrating manufacturing strategy and project management would be the creation of an integral model which would essentially increase the efficiency of the processes of manufacturing strategy formulation and implementation through projects. The aim would be to design an overall concept of strategic manufacturing management: project-based strategic manufacturing management. The key issue would be in linking manufacturing strategy formulation processes with a project implementation process where project definition commences prior to the completion of the manufacturing strategy formulation process. Thus, the manufacturing strategy formulation and implementation processes would be shortened and the lag between manufacturing strategy formulation and implementation shortened. Competitiveness would be gained from developing and accelerating the strategic manufacturing processes. Hauc and Kovac (2000) have discussed this research opportunity from a generic strategy formulation and implementation perspective.

The methodology should be further evaluated with more case study research. This would extend the generalisation and give added validity to the case research. Limited evaluation was possible during the timeframe to understand the impact of the methodology in a diverse range of manufacturing organisations, and its long-term effects. Further evaluation will provide a deeper understanding of the methodology and may lead to further refinement.

Numerous factors can affect the success or the failure of the use and application of a methodology. The literature examined fails to provide a research method that would unequivocally establish to what extent the applicability and success of a methodology are dependent on the methodology used or on other factors such as company's culture or existing organisation's systems and policies. Future research should continue to address this issue.

From the results of the survey of practitioners set out to identify the key success factors in the implementation of strategic manufacturing initiatives where the human side of a project was identified as the most critical factor, and from the primary evaluation of the methodology where most practitioners in manufacturing did not follow any structured methodology for the implementation of SMIs, we can formulate the following hypothesis: "the human side of strategic projects in manufacturing is so critical because manufacturing organisations are lacking of an appropriate project management methodology for the implementation of SMIs. Thus they solely rely on the skills and experience of individuals to create the right direction, steps and tools and techniques that make the progress of the project a success". Future research should test this hypothesis and identify and analyse what methodologies are used in practice for the management and implementation of SMIs.

This section has examined areas for further work which the researcher anticipates would foster research aiming to contribute to knowledge in the implementation of strategic manufacturing initiatives. The recommendations in this section also identify ways in which some of the limitations of this research can be addressed.

11.6 Concluding Remarks

This concluding chapter has given accounts of the principal research findings against the research aim, and discussed major contributions to knowledge. The limitations of the research have been identified and finally recommendations for future work suggested. It is hoped that the main contributions that this thesis has made to the body of knowledge will be relevant in theory and practice.

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Appendices

Appendix A: The 106 Factors from Literature included in the Practitioners' Survey

A.PROJECT MANAGER

1. Good knowledge and understanding of business and manufacturing strategies and strategic goals (Umble et al, 2003; Pellegrinelli and Bowman, 1994)
2. Involved in manufacturing strategy formulation (Blackburn, 2002; Papke-Shields and Malhotra, 2001; Al-Ghamdi, 1998)
3. Trained in Project Management (Pellegrinelli and Bowman, 1994; Milis and Mercken, 2002; Hartman and Ashrafi, 2002; Maylor, 2001; Clarke, 1999)
4. Committed to project scope (Clarke, 1999)
5. "Project Manager" is a position in the organisational structure of the company (Pellegrinelli and Bowman, 1994)
6. The Project Manager is assigned to the SMI project on a FULL TIME basis (Pellegrinelli and Bowman, 1994)
7. Experience with similar projects (Milis and Mercken, 2002)
8. Project manager is able to release the energies of his subordinates, project team members, ... (El-Sabaa, 2001)
9. Communication: Project manager is able to listen, understand, and communicate accurately and constantly (El-Sabaa, 2001; Clarke, 1999; Milis and Mercken, 2002)
10. Coping with situations: Project manager is flexible, patient, and persistent (El-Sabaa, 2001; Milis and Mercken, 2002)
11. Delegating Authority: Project manager is able to give people the opportunity as group members to participate in making decisions (El-Sabaa, 2001; Maylor, 2001; Milis and Mercken, 2002)
12. Political sensitivity: Project manager perceives and recognises the attitudes of his superiors, equals, or subordinates and he accordingly behaves (El-Sabaa, 2001; Pinto, 2000)
13. High self-esteem (El-Sabaa, 2001)

14. Enthusiasm, positive attitude, creative thinking (El-Sabaa, 2001; Milis and Mercken, 2002)
15. Planning skills (El-Sabaa, 2001)
16. Organizing skills (El-Sabaa, 2001)
17. Strong goal orientation (El-Sabaa, 2001)
18. Ability to see the project as a whole (El-Sabaa, 2001)
19. Ability to visualize the relationship of the project to the industry and the community (El-Sabaa, 2001; Clarke, 1999)
20. Strong problem solving orientation (El-Sabaa, 2001)
21. Special knowledge in the use of analysis tools and techniques (El-Sabaa, 2001; Clarke and Garside, 1997)
22. Knowledge and understanding of manufacturing operations (El-Sabaa, 2001)
23. Understanding of organisational methods, processes, procedures and policies (El-Sabaa, 2001)
24. Experience or knowledge of the technology required and the subject matter of the project (El-Sabaa, 2001)
25. Skills in the use of computers (El-Sabaa, 2001; Milis and Mercken, 2002)
26. Skills in finance and accounting (PMI, 2000)
27. High level of authority (Pinto, 2000)
28. Empowered, rapid decision making (Pinto, 2000)
29. High knowledge of the company (functions, departments, hierarchy, people)
30. Negotiation and Persuasion skills (Pinto, 2000)
31. Keeps accurate records of every action/decision
32. Personal reward system (Marucheck et al, 1990)
33. Clear career path after project completion (El-Sabaa, 2001)
34. The same Project Manager stays during the whole duration of the strategic implementation (Al-Ghamdi, 1998)

B.TOP/SENIOR MANAGEMENT

35. Good knowledge and understanding of business and manufacturing strategies and strategic goals (Umble et al, 2003; Van Der Merwe, 2002; Pellegrinelli and Bowman, 1994)

36. Involved in strategy formulation (Papke-Shields and Malhotra, 2001; Al-Ghamdi, 1998)
37. Trained in Project Management (Hartman and Ashrafi, 2002; Van Der Merwe, 2002; Maylor, 2001; Clarke, 1999)
38. Committed to project scope (Umble et al, 2003; Van Der Merwe, 2002; Clarke, 1999; Clarke and Garside, 1997)
39. Provides full, active and clearly visible support to the project during its whole life (Pellegrinelli and Bowman, 1994; Milis and Mercken, 2002; Marucheck et al, 1990; Hartman and Ashrafi, 2002)
40. Trained in how to be good project clients (Pellegrinelli and Bowman, 1994; Van Der Merwe, 2002)
41. There is an executive management planning committee or project Steering Group formed by Top/Senior Management (Pellegrinelli and Bowman, 1994; Umble et al, 2003; Clarke and Garside, 1997)
42. Enthusiasm, positive attitude, creative thinking (Milis and Mercken, 2002; Marucheck et al, 1990)
43. Bypass existing systems, structures and hierarchies in favour of successful strategy implementation (Pellegrinelli and Bowman, 1994; Marucheck et al, 1990)
44. The same Top/Senior Management stays during the whole duration of the strategic implementation (Al-Ghamdi, 1998)

C.PROJECT TEAM MEMBERS

45. Good knowledge and understanding of business and manufacturing strategies and strategic goals (Umble et al, 2003; Milis and Mercken, 2002)
46. Involved in strategy formulation (Papke-Shields and Malhotra, 2001; Al-Ghamdi, 1998)
47. Trained in Project Management (Hartman and Ashrafi, 2002; Garvin, 1993; Clarke, 1999)
48. Committed to project scope (Marucheck et al, 1990; Clarke, 1999; Milis and Mercken, 2002)
49. Empowered, rapid decision making (Maylor, 2001)

50. Project evaluation measures are very clear to team members and included from the beginning (Hartman and Ashrafi, 2002; Milis and Mercken, 2002; Clarke, 1999)
51. Individual reward system (Marucheck et al, 1990; Milis and Mercken, 2002; Maylor, 2001)
52. When team goals are reached, rewards should be presented in a very visible way (Milis and Mercken, 2002)
53. Changes in responsibilities are clearly defined and understood (Marucheck et al, 1990)
54. Full time members (Pinto, 2000)
55. Multifunctional members from different departments (Pinto, 2000; Van Der Merwe, 2002; Milis and Mercken, 2002)
56. If someone is unable to achieve agreed-upon objectives, they should either receive the needed assistance or be replaced
57. Team is composed of top-notch people who are chosen for their skills, past accomplishments, reputation, and flexibility (Umble et al, 2003)
58. Project Team members keep accurate records of every action/decision
59. Stability: New major Departmental / Functional / Non-project-related responsibilities are not created during project life (Milis and Mercken, 2002)
60. Enthusiasm, positive attitude, creative thinking (Milis and Mercken, 2002)
61. Motivated (Milis and Mercken, 2002; Clarke, 1999)
62. Good relationship among project team members (Milis and Mercken, 2002)
63. The same Project Team members stay during the whole duration of the strategic implementation (Al-Ghamdi, 1998)

D.MANUFACTURING EMPLOYEES (non project team members but affected by the project)

64. Good knowledge and understanding of business and manufacturing strategies and strategic goals (Umble et al, 2003; Marucheck et al, 1990)
65. Involved in strategy formulation (Papke-Shields and Malhotra, 2001; Al-Ghamdi, 1998)
66. Trained in Project Management (Hartman and Ashrafi, 2002; Clarke, 1999)

67. Committed to project scope (Al-Ghamdi, 1998; Clarke, 1999)
68. Awareness of the project (Al-Ghamdi, 1998; Marucheck et al, 1990; Clarke, 1999)
69. Understanding of project scope (Al-Ghamdi, 1998; Clarke, 1999)
70. Trained in how to work with the new practice/system/application/technology, the outcome and its advantages (Milis and Mercken, 2002; Marucheck et al, 1990)
71. Involved in project development and execution (constrained by the nature of the project). (Marucheck et al, 1990)
72. Enthusiasm, positive attitude, creative thinking (Milis and Mercken, 2002)

E.STRATEGIC LINK & COMPANY-WIDE

73. SMI Project (s) implementation is considered in the process of development and formulation of strategy (Hauc and Kovac, 2000; Papke-Shields and Malhotra, 2001; Al-Ghamdi, 1998)
74. The organisation engages in excellent project management including clear scope definition, resource planning, project progress tracking system, and business processes change management. (Umble et al, 2003; Hartman and Ashrafi, 2002; Van Der Merwe, 2002; Pellegrinelli and Bowman, 1994)
75. Organisational Change Management techniques are utilised (people, structures, skills,...) (Umble et al, 2003; Milis and Mercken, 2002; Hartman and Ashrafi, 2002)
76. Portfolio and programme management practices are used and allow the enterprise to resource fully a suite of projects that are thoughtfully and dynamically matched to the corporate strategy and business objectives. (Cooke-Davies, 2002; Marucheck et al, 1990; Maylor, 2001)
77. A sense of urgency is maintained during the life of the project (Cooke-Davies, 2002)
78. All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales). (Cooke-Davies, 2002; Hartman and Ashrafi, 2002; Clarke, 1999)

79. Key implementation tasks and milestones are sufficiently defined (Hartman and Ashrafi, 2002; Clarke, 1999)
80. The 'financial unit of analysis or cost/benefit analysis' of sub-projects is extended to cover the wider effect of the complete Strategic Manufacturing Initiative implementation project (Grundy, 1998)
81. Information systems used to monitor implementation at all levels are adequate (Al-Ghamdi, 1998; Clarke, 1999)
82. The integrity of the performance measurement baseline is maintained (Cooke-Davies, 2002)
83. The time span for project completion is flexible if new or continuous improvement initiatives are generated during the process (Cooke-Davies, 2002)
84. Keep project (or project stage duration) as far below 3 years as possible (1 year is better). (Cooke-Davies, 2002; Marucheck et al, 1990; Garvin, 1993)
85. Adequacy of company-wide education on the concepts of risk management. (Cooke-Davies, 2002; Hartman and Ashrafi, 2002)
86. Maturity of the organisation's processes for assigning ownership of risks. (Cooke-Davies, 2002; Hartman and Ashrafi, 2002)
87. There is an effective benefits delivery and management process that involves the mutual co-operation of project management and line management functions (Cooke-Davies, 2002; Marucheck et al, 1990)
88. There is an effective means of "learning from experience" on projects in a way that encourages continuous improvement of project management processes and practices. (Cooke-Davies, 2002; Pellegrinelli and Bowman, 1994; Maylor, 2001; Clarke, 1999)
89. SMI Project (s) is defined rigorously, but at the same time there is some latitude in terms of fluidity of scope and focus within the project definition (Grundy, 1998; Maylor, 2001; Pellegrinelli and Bowman, 1994)
90. There is a limited number of projects being implemented in manufacturing at any one time in order to provide focus and prioritise resources (Maylor, 2001; Garvin, 1993; Clarke, 1999)

91. Sufficient resources are at the disposal of the project manager/team (Milis and Mercken, 2002; Marucheck et al, 1990; Maylor, 2001; Clarke, 1999)
92. Competing or departmental activities don't distract attention from implementing the strategic initiative (Al-Ghamdi, 1998; Maylor, 2001)
93. Supportive structures are in place to help individuals access easily what they need for facilitating the implementation process (Al-Ghamdi, 1998; Marucheck et al, 1990; Maylor, 2001)

F.SOCIAL & EXTERNAL INFLUENCES (Milis and Mercken, 2002; Al-Ghamdi, 1998; Alexander, 1985)

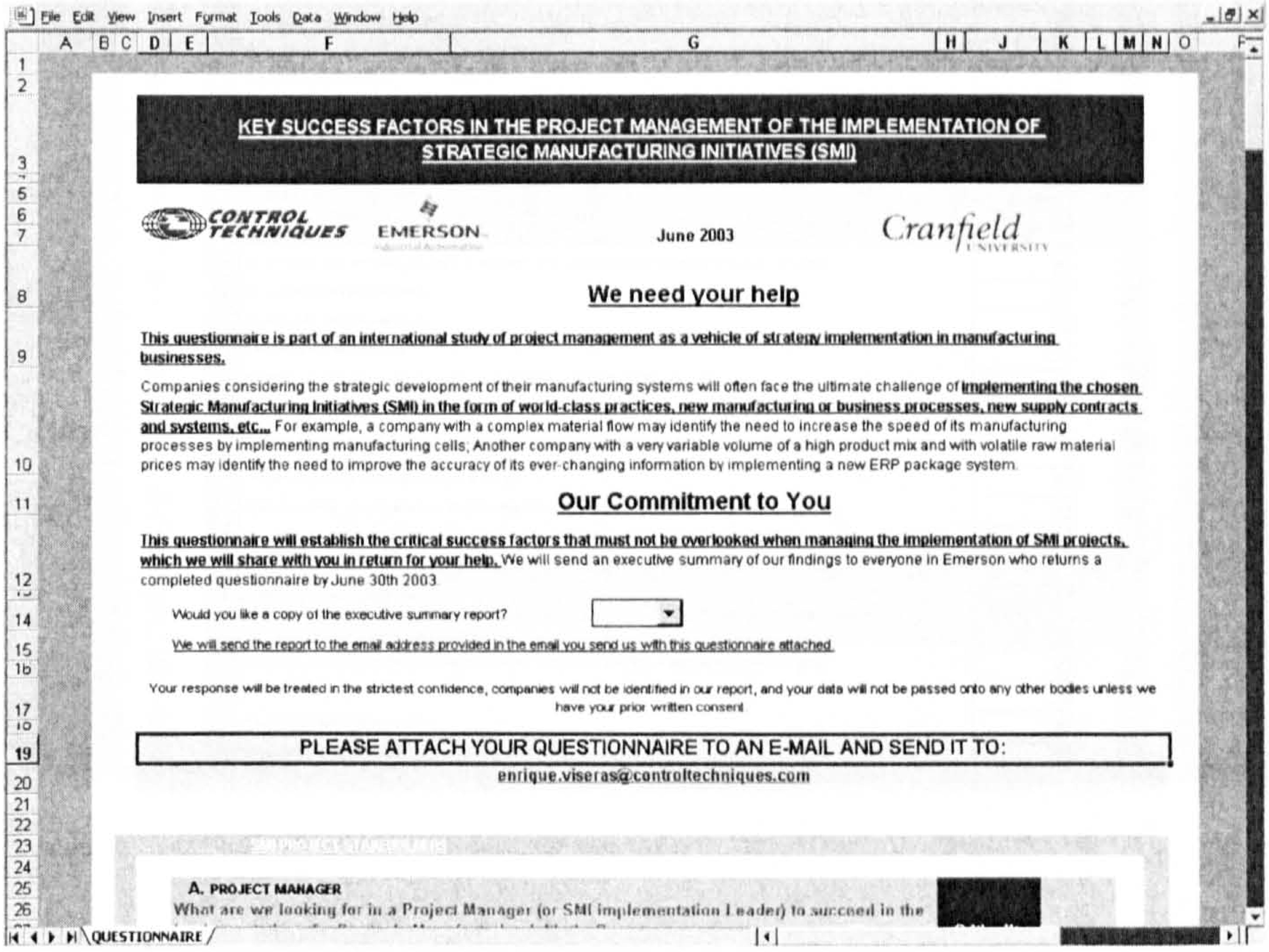
94. SMI project (s) is launched during a good situation for the national economy and the industry in general (macroeconomics)
95. SMI project (s) is launched during a good financial situation for the specific company (microeconomics)
96. Consideration is given to sensitive workforce issues
97. Project creates a feeling of needed change for the better, change for the future

G.PROJECT MANAGEMENT PROCESSES

98. Project Integration Management. Processes required to ensure that the various elements of the project are properly coordinated. (PMI, 2000)
99. Project Scope Management. Processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. (PMI, 2000)
100. Project Time Management. Processes required to ensure timely completion of the project. (PMI, 2000)
101. Project Cost Management. Processes required to ensure that the project is completed within the approved budget. (PMI, 2000)
102. Project Quality Management. Processes required to ensure that the project will satisfy the needs for which it was undertaken. (PMI, 2000)
103. Project Human Resource Management. Processes required to make the most effective use of the people involved with the project. (PMI, 2000)

104. Project Communications Management. Processes required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information. (PMI, 2000; Clarke, 1999)
105. Project Risk Management. Processes concerned with identifying, analysing, and responding to project risk. (PMI, 2000; Hartman and Ashrafi, 2002; Cooke-Davies, 2002)
106. Project Procurement Management. Processes required to acquire goods and services from outside the performing organisation. (PMI, 2000)

Appendix B: Electronic Questionnaire Format used in the Practitioners' Survey



KEY SUCCESS FACTORS IN THE PROJECT MANAGEMENT OF THE IMPLEMENTATION OF STRATEGIC MANUFACTURING INITIATIVES (SMI)

CONTROL TECHNIQUES EMERSON June 2003 Cranfield UNIVERSITY

We need your help

This questionnaire is part of an international study of project management as a vehicle of strategy implementation in manufacturing businesses.

Companies considering the strategic development of their manufacturing systems will often face the ultimate challenge of **implementing the chosen Strategic Manufacturing Initiatives (SMI) in the form of world-class practices, new manufacturing or business processes, new supply contracts and systems, etc...** For example, a company with a complex material flow may identify the need to increase the speed of its manufacturing processes by implementing manufacturing cells; Another company with a very variable volume of a high product mix and with volatile raw material prices may identify the need to improve the accuracy of its ever-changing information by implementing a new ERP package system.

Our Commitment to You

This questionnaire will establish the critical success factors that must not be overlooked when managing the implementation of SMI projects, which we will share with you in return for your help. We will send an executive summary of our findings to everyone in Emerson who returns a completed questionnaire by June 30th 2003.

Would you like a copy of the executive summary report?

We will send the report to the email address provided in the email you send us with this questionnaire attached.

Your response will be treated in the strictest confidence, companies will not be identified in our report, and your data will not be passed onto any other bodies unless we have your prior written consent.

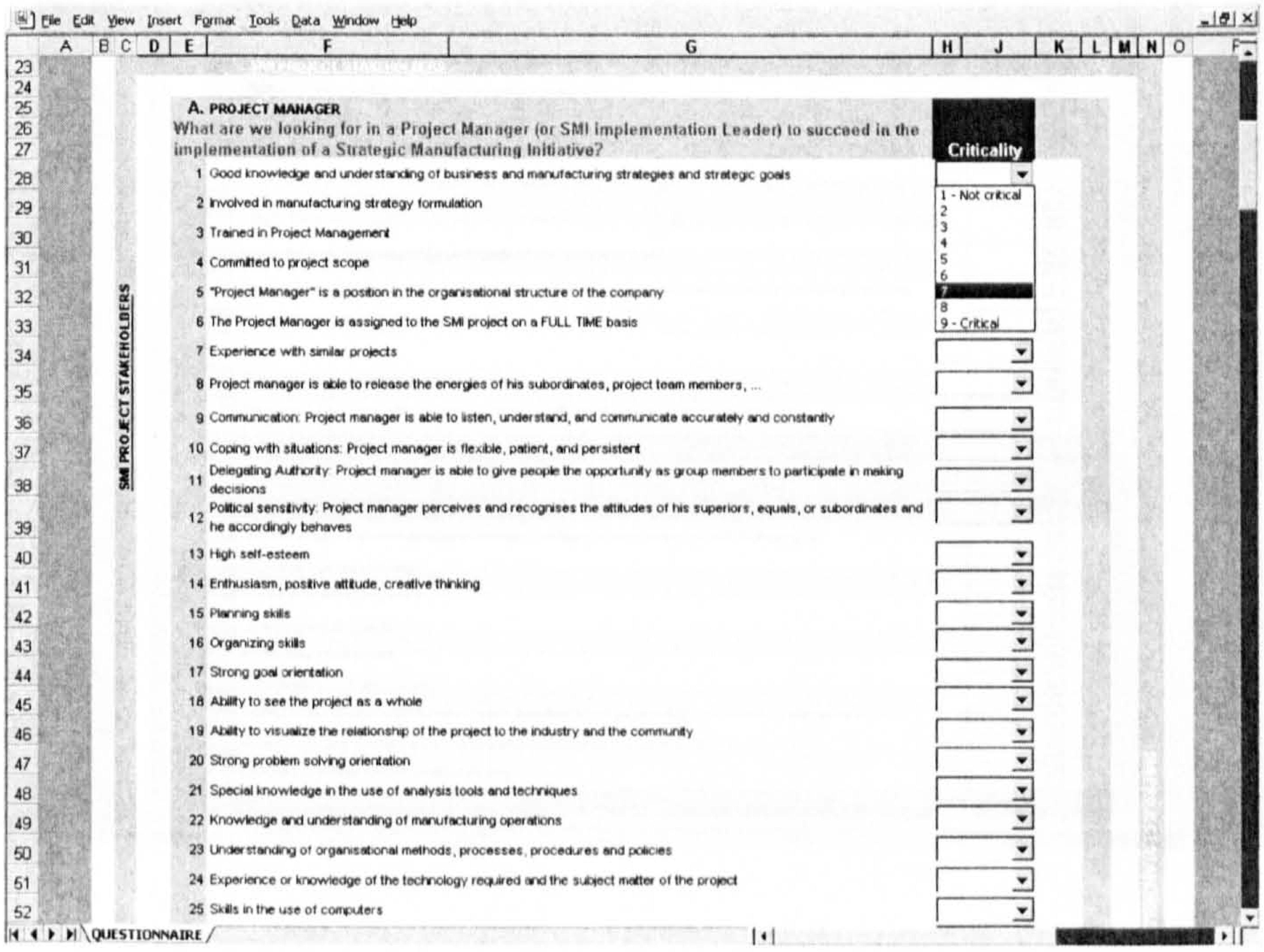
PLEASE ATTACH YOUR QUESTIONNAIRE TO AN E-MAIL AND SEND IT TO:

enrique.viseras@controltechniques.com

A. PROJECT MANAGER

What are we looking for in a Project Manager (or SMI implementation Leader) to succeed in the

QUESTIONNAIRE



SMI PROJECT STAKEHOLDERS

A. PROJECT MANAGER

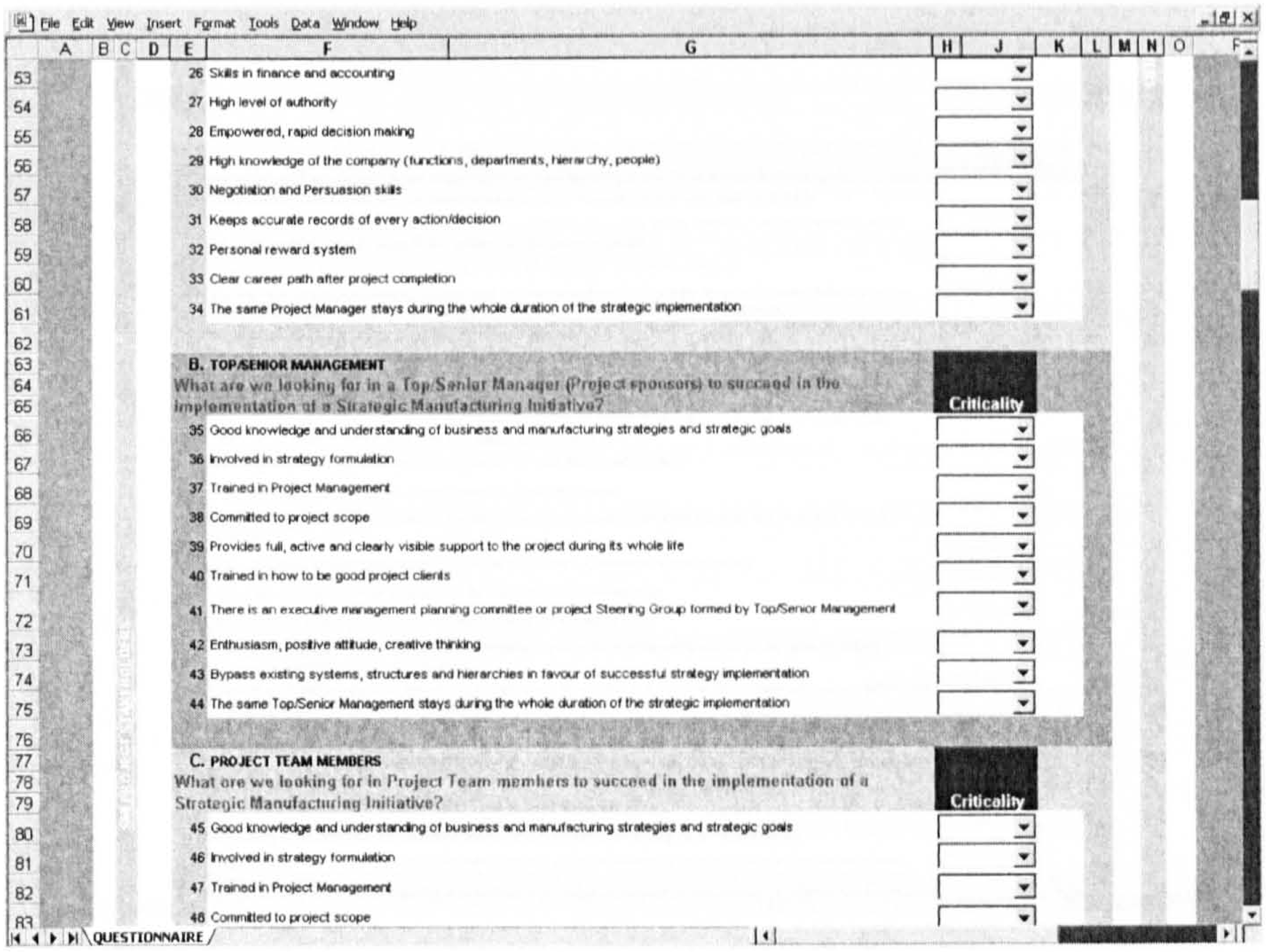
What are we looking for in a Project Manager (or SMI implementation Leader) to succeed in the implementation of a Strategic Manufacturing Initiative?

Criticality

1 - Not critical, 2, 3, 4, 5, 6, 7, 8, 9 - Critical

1 Good knowledge and understanding of business and manufacturing strategies and strategic goals
2 Involved in manufacturing strategy formulation
3 Trained in Project Management
4 Committed to project scope
5 "Project Manager" is a position in the organisational structure of the company
6 The Project Manager is assigned to the SMI project on a FULL TIME basis
7 Experience with similar projects
8 Project manager is able to release the energies of his subordinates, project team members, ...
9 Communication: Project manager is able to listen, understand, and communicate accurately and constantly
10 Coping with situations: Project manager is flexible, patient, and persistent
11 Delegating Authority: Project manager is able to give people the opportunity as group members to participate in making decisions
12 Political sensitivity: Project manager perceives and recognises the attitudes of his superiors, equals, or subordinates and he accordingly behaves
13 High self-esteem
14 Enthusiasm, positive attitude, creative thinking
15 Planning skills
16 Organizing skills
17 Strong goal orientation
18 Ability to see the project as a whole
19 Ability to visualize the relationship of the project to the industry and the community
20 Strong problem solving orientation
21 Special knowledge in the use of analysis tools and techniques
22 Knowledge and understanding of manufacturing operations
23 Understanding of organisational methods, processes, procedures and policies
24 Experience or knowledge of the technology required and the subject matter of the project
25 Skills in the use of computers

QUESTIONNAIRE



26 Skills in finance and accounting
27 High level of authority
28 Empowered, rapid decision making
29 High knowledge of the company (functions, departments, hierarchy, people)
30 Negotiation and Persuasion skills
31 Keeps accurate records of every action/decision
32 Personal reward system
33 Clear career path after project completion
34 The same Project Manager stays during the whole duration of the strategic implementation

B. TOP/SENIOR MANAGEMENT

What are we looking for in a Top/Senior Manager (Project sponsors) to succeed in the implementation of a Strategic Manufacturing Initiative? — **Criticality**

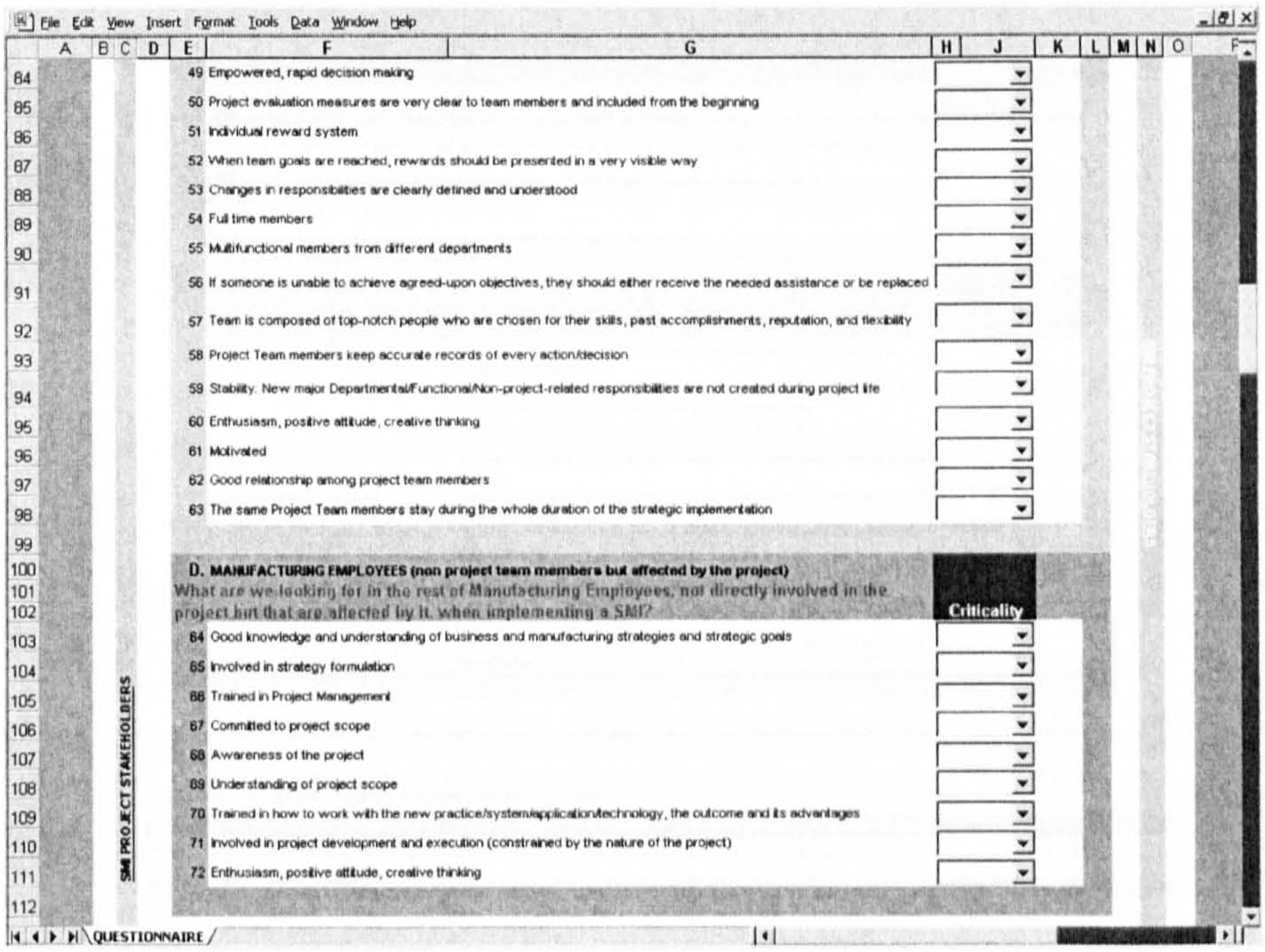
35 Good knowledge and understanding of business and manufacturing strategies and strategic goals
36 Involved in strategy formulation
37 Trained in Project Management
38 Committed to project scope
39 Provides full, active and clearly visible support to the project during its whole life
40 Trained in how to be good project clients
41 There is an executive management planning committee or project Steering Group formed by Top/Senior Management
42 Enthusiasm, positive attitude, creative thinking
43 Bypass existing systems, structures and hierarchies in favour of successful strategy implementation
44 The same Top/Senior Management stays during the whole duration of the strategic implementation

C. PROJECT TEAM MEMBERS

What are we looking for in Project Team members to succeed in the implementation of a Strategic Manufacturing Initiative? — **Criticality**

45 Good knowledge and understanding of business and manufacturing strategies and strategic goals
46 Involved in strategy formulation
47 Trained in Project Management
48 Committed to project scope

QUESTIONNAIRE



49 Empowered, rapid decision making
50 Project evaluation measures are very clear to team members and included from the beginning
51 Individual reward system
52 When team goals are reached, rewards should be presented in a very visible way
53 Changes in responsibilities are clearly defined and understood
54 Full time members
55 Multifunctional members from different departments
56 If someone is unable to achieve agreed-upon objectives, they should either receive the needed assistance or be replaced
57 Team is composed of top-notch people who are chosen for their skills, past accomplishments, reputation, and flexibility
58 Project Team members keep accurate records of every action/decision
59 Stability. New major Departmental/Functional/Non-project-related responsibilities are not created during project life
60 Enthusiasm, positive attitude, creative thinking
61 Motivated
62 Good relationship among project team members
63 The same Project Team members stay during the whole duration of the strategic implementation

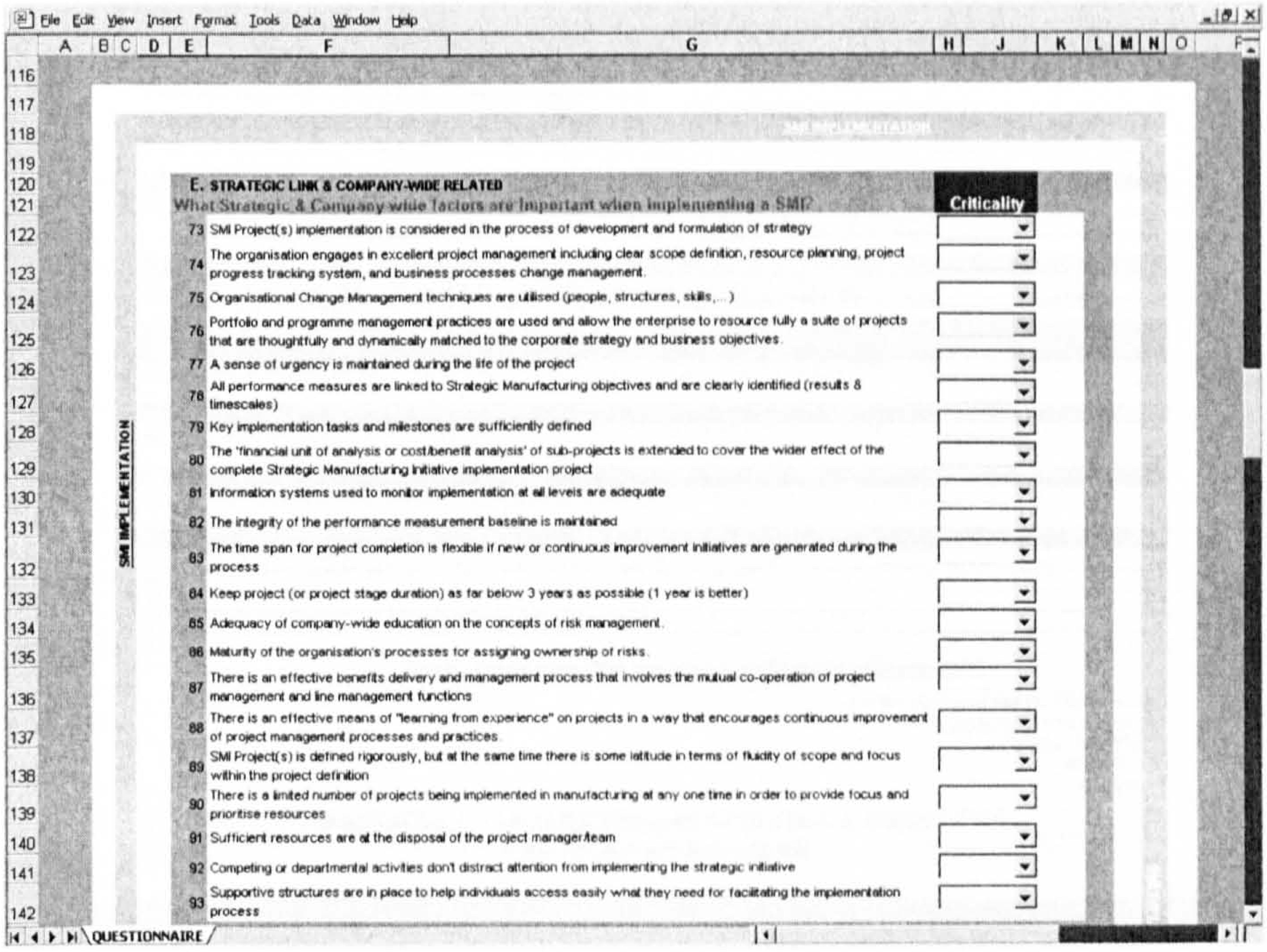
D. MANUFACTURING EMPLOYEES (non project team members but affected by the project)

What are we looking for in the rest of Manufacturing Employees, not directly involved in the project but that are affected by it, when implementing a SMI? — **Criticality**

64 Good knowledge and understanding of business and manufacturing strategies and strategic goals
65 Involved in strategy formulation
66 Trained in Project Management
67 Committed to project scope
68 Awareness of the project
69 Understanding of project scope
70 Trained in how to work with the new practice/system/application/technology, the outcome and its advantages
71 Involved in project development and execution (constrained by the nature of the project)
72 Enthusiasm, positive attitude, creative thinking

SMI PROJECT STAKEHOLDERS

QUESTIONNAIRE



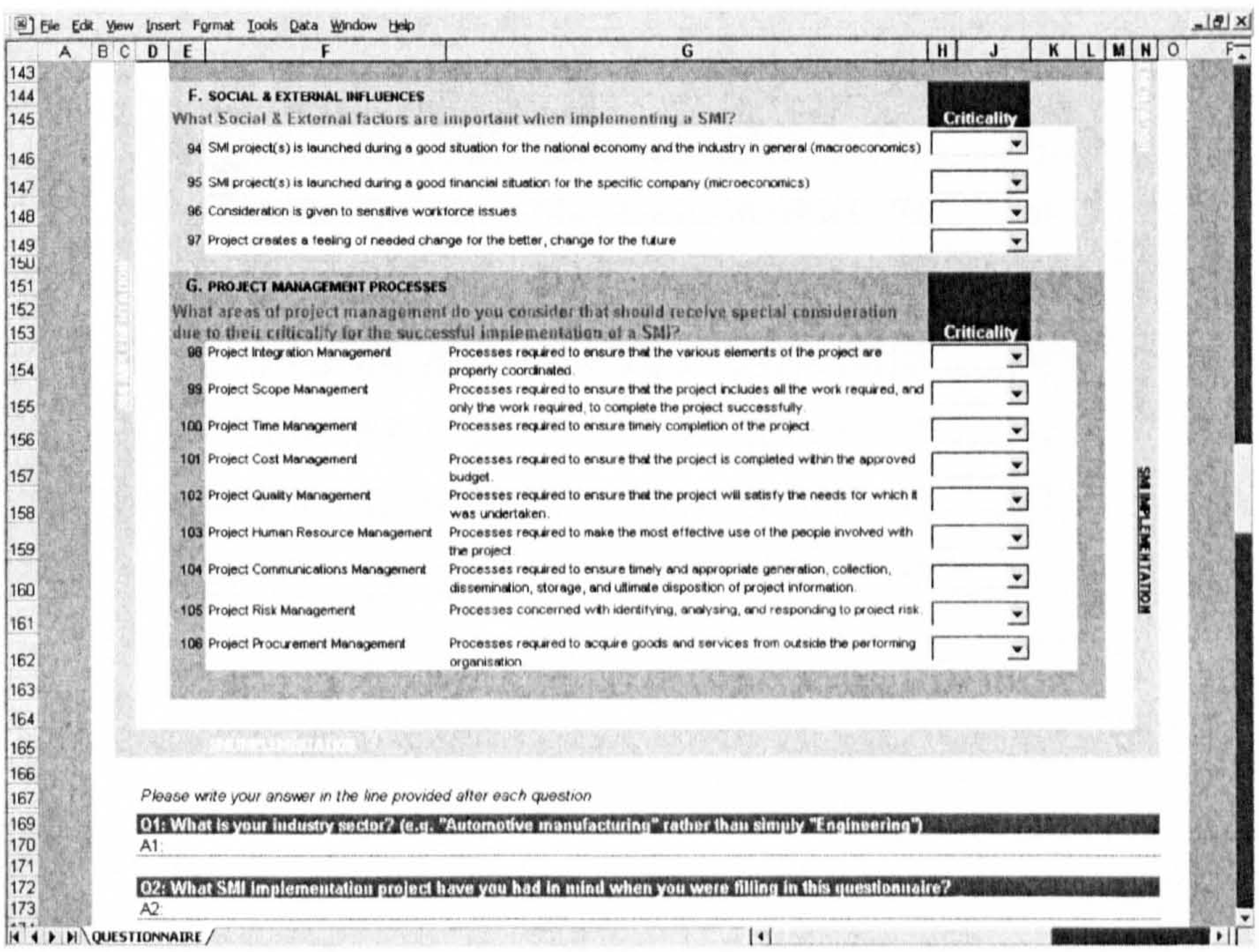
E. STRATEGIC LINK & COMPANY-WIDE RELATED

What Strategic & Company wide factors are important when implementing a SMI?

		Criticality
73	SMI Project(s) implementation is considered in the process of development and formulation of strategy	
74	The organisation engages in excellent project management including clear scope definition, resource planning, project progress tracking system, and business processes change management.	
75	Organisational Change Management techniques are utilised (people, structures, skills,...)	
76	Portfolio and programme management practices are used and allow the enterprise to resource fully a suite of projects that are thoughtfully and dynamically matched to the corporate strategy and business objectives.	
77	A sense of urgency is maintained during the life of the project	
78	All performance measures are linked to Strategic Manufacturing objectives and are clearly identified (results & timescales)	
79	Key implementation tasks and milestones are sufficiently defined	
80	The 'financial unit of analysis or cost/benefit analysis' of sub-projects is extended to cover the wider effect of the complete Strategic Manufacturing Initiative implementation project	
81	Information systems used to monitor implementation at all levels are adequate	
82	The integrity of the performance measurement baseline is maintained	
83	The time span for project completion is flexible if new or continuous improvement initiatives are generated during the process	
84	Keep project (or project stage duration) as far below 3 years as possible (1 year is better)	
85	Adequacy of company-wide education on the concepts of risk management.	
86	Maturity of the organisation's processes for assigning ownership of risks.	
87	There is an effective benefits delivery and management process that involves the mutual co-operation of project management and line management functions	
88	There is an effective means of "learning from experience" on projects in a way that encourages continuous improvement of project management processes and practices.	
89	SMI Project(s) is defined rigorously, but at the same time there is some latitude in terms of fluidity of scope and focus within the project definition	
90	There is a limited number of projects being implemented in manufacturing at any one time in order to provide focus and prioritise resources	
91	Sufficient resources are at the disposal of the project manager/team	
92	Competing or departmental activities don't distract attention from implementing the strategic initiative	
93	Supportive structures are in place to help individuals access easily what they need for facilitating the implementation process	

SMI IMPLEMENTATION

QUESTIONNAIRE



F. SOCIAL & EXTERNAL INFLUENCES

What Social & External factors are important when implementing a SMI?

		Criticality
94	SMI project(s) is launched during a good situation for the national economy and the industry in general (macroeconomics)	
95	SMI project(s) is launched during a good financial situation for the specific company (microeconomics)	
96	Consideration is given to sensitive workforce issues	
97	Project creates a feeling of needed change for the better, change for the future	

G. PROJECT MANAGEMENT PROCESSES

What areas of project management do you consider that should receive special consideration due to their criticality for the successful implementation of a SMI?

			Criticality
98	Project Integration Management	Processes required to ensure that the various elements of the project are properly coordinated.	
99	Project Scope Management	Processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully.	
100	Project Time Management	Processes required to ensure timely completion of the project.	
101	Project Cost Management	Processes required to ensure that the project is completed within the approved budget.	
102	Project Quality Management	Processes required to ensure that the project will satisfy the needs for which it was undertaken.	
103	Project Human Resource Management	Processes required to make the most effective use of the people involved with the project.	
104	Project Communications Management	Processes required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information.	
105	Project Risk Management	Processes concerned with identifying, analysing, and responding to project risk.	
106	Project Procurement Management	Processes required to acquire goods and services from outside the performing organisation	

SMI IMPLEMENTATION

Please write your answer in the line provided after each question

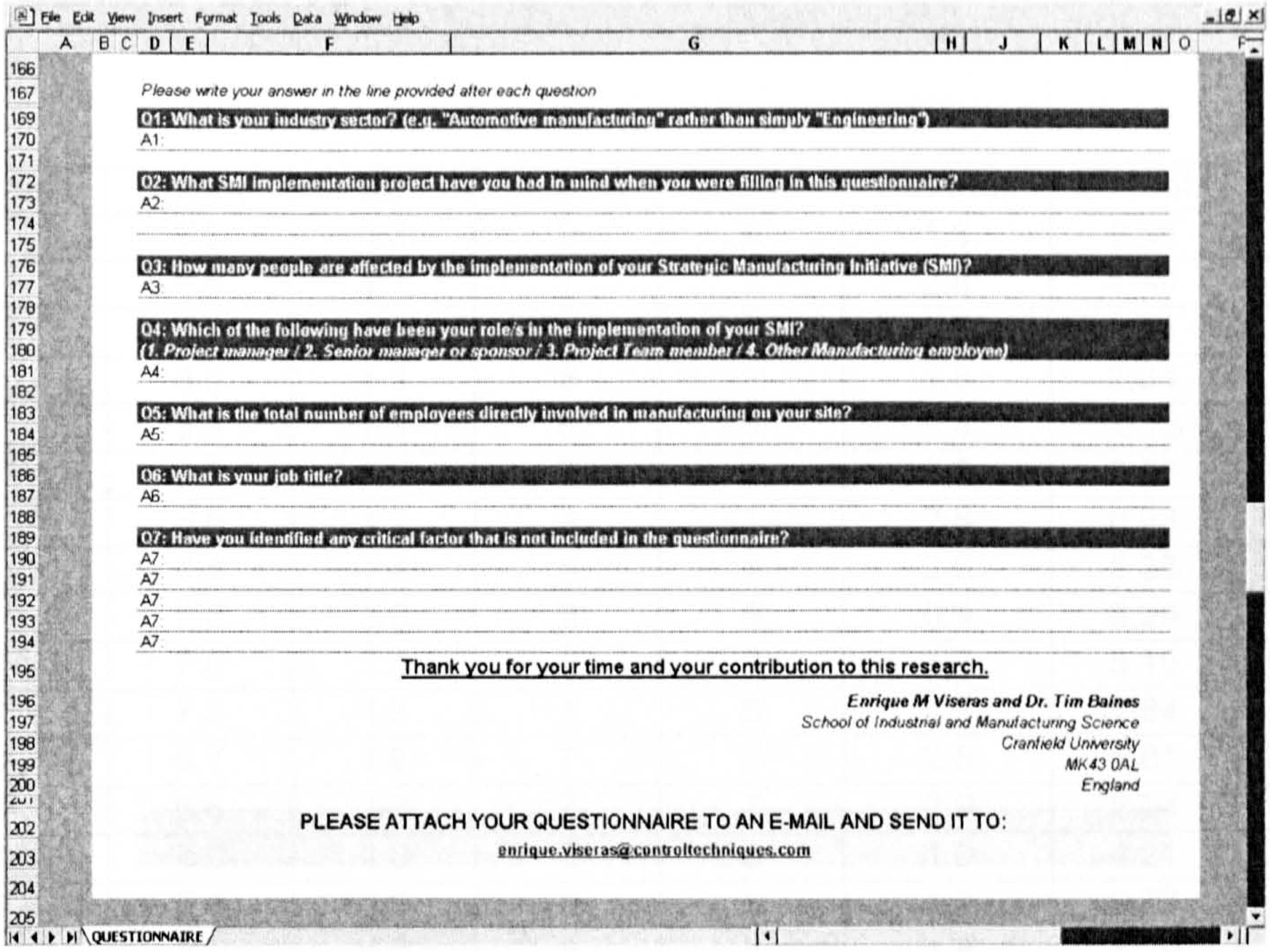
Q1: What is your industry sector? (e.g. "Automotive manufacturing" rather than simply "Engineering")

A1:

Q2: What SMI implementation project have you had in mind when you were filling in this questionnaire?

A2:

QUESTIONNAIRE



Please write your answer in the line provided after each question

Q1: What is your industry sector? (e.g. "Automotive manufacturing" rather than simply "Engineering")

A1:

Q2: What SMI implementation project have you had in mind when you were filling in this questionnaire?

A2:

Q3: How many people are affected by the implementation of your Strategic Manufacturing Initiative (SMI)?

A3:

Q4: Which of the following have been your role/s in the implementation of your SMI?
(1. Project manager / 2. Senior manager or sponsor / 3. Project Team member / 4. Other Manufacturing employee)

A4:

Q5: What is the total number of employees directly involved in manufacturing on your site?

A5:

Q6: What is your job title?

A6:

Q7: Have you identified any critical factor that is not included in the questionnaire?

A7:
A7:
A7:
A7:
A7:

Thank you for your time and your contribution to this research.

Enrique M Viseras and Dr. Tim Baines
School of Industrial and Manufacturing Science
Cranfield University
MK43 0AL
England

PLEASE ATTACH YOUR QUESTIONNAIRE TO AN E-MAIL AND SEND IT TO:
enrique.viseras@controltechniques.com

Appendix C: Statistical Analysis of the Results of the Practitioners' Survey

Questions	mean	SD	median	mode	variance	kurtosis	skewness
1	7.8	1.3	8	9	1.8	0.66	-1.02
2	6.6	1.7	7	7	2.8	1.49	-0.99
3	7.2	1.6	7.5	8	2.6	0.24	-0.82
4	8.0	1.3	8	9	1.8	2.34	-1.52
5	5.3	2.3	6	6	5.4	-0.73	-0.33
6	6.9	1.9	7	7	3.8	0.60	-0.98
7	6.0	1.7	6	7	2.8	0.93	-0.78
8	7.4	1.4	8	8	2.0	3.38	-1.37
9	8.3	1.0	9	9	0.9	8.99	-2.39
10	7.6	1.3	8	8	1.7	5.19	-1.80
11	7.4	1.3	8	8	1.7	4.84	-1.47
12	6.7	1.6	7	7	2.5	1.81	-0.95
13	6.6	1.7	7	7	2.9	2.04	-1.21
14	8.0	1.0	8	8	1.0	4.21	-1.36
15	7.8	1.1	8	8	1.2	0.77	-0.83
16	7.7	1.2	8	8	1.4	8.29	-1.99
17	7.8	1.0	8	8	1.0	1.42	-1.00
18	7.8	1.2	8	9	1.4	1.58	-1.12
19	6.0	1.7	6	7	2.9	1.08	-0.81
20	7.4	1.2	7	7	1.6	2.44	-1.00
21	6.4	1.4	7	7	2.1	0.86	-0.62
22	6.8	1.6	7	7	2.5	1.13	-0.86
23	6.6	1.5	7	7	2.1	0.79	-0.73
24	6.4	1.5	7	7	2.2	1.80	-1.14
25	6.4	1.8	7	7	3.2	1.69	-1.01
26	5.5	1.7	6	7	2.9	-0.12	-0.48
27	6.4	1.7	7	7	3.0	0.47	-0.66
28	7.3	1.4	7	7	1.8	0.99	-0.87
29	6.4	1.6	7	7	2.5	2.06	-1.30
30	7.3	1.3	7	8	1.8	1.94	-0.95
31	6.7	1.6	7	7	2.5	0.92	-0.75
32	5.9	1.7	6	6	2.8	0.83	-0.66
33	5.7	2.1	6	6	4.4	-0.41	-0.43
34	7.4	1.6	8	8	2.7	3.78	-1.71
35	8.1	1.1	8	9	1.1	-0.48	-0.79

Questions	mean	SD	median	mode	variance	kurtosis	skewness
36	7.8	1.4	8	9	1.8	5.94	-1.93
37	5.8	2.0	6	7	4.1	0.19	-0.68
38	8.3	1.1	9	9	1.1	3.27	-1.74
39	8.0	1.2	8	9	1.5	0.84	-1.14
40	5.8	1.8	6	7	3.3	0.81	-0.99
41	6.9	1.7	7	7	3.0	1.36	-1.04
42	7.4	1.2	8	7	1.4	1.22	-0.86
43	6.4	2.0	7	7	4.1	0.34	-0.86
44	6.5	2.0	7	8	4.1	0.36	-0.91
45	6.4	1.7	6.5	6	2.9	1.02	-0.85
46	5.3	1.9	5	7	3.7	-0.47	-0.27
47	5.3	1.9	6	7	3.7	-0.11	-0.54
48	7.6	1.3	8	9	1.8	2.12	-1.31
49	6.5	1.6	7	6	2.5	2.18	-1.14
50	8.1	1.0	8	9	1.1	0.79	-1.07
51	6.0	1.9	6	7	3.5	0.46	-0.73
52	7.0	1.5	7	7	2.4	-0.28	-0.46
53	7.6	1.3	8	9	1.7	-0.58	-0.59
54	5.6	2.3	6	7	5.2	-0.90	-0.28
55	7.6	1.4	8	9	2.0	0.46	-0.98
56	7.1	1.4	7	7	1.9	-0.13	-0.43
57	6.7	1.8	7	7	3.3	1.69	-1.16
58	6.3	1.9	7	7	3.6	0.55	-0.75
59	5.7	1.9	6	5	3.5	-0.15	-0.28
60	7.8	1.2	8	9	1.4	1.77	-1.10
61	8.0	1.1	8	8	1.2	4.40	-1.56
62	7.4	1.2	7.5	8	1.5	0.10	-0.69
63	6.8	1.8	7	7	3.4	1.78	-1.31
64	5.0	2.1	5	5	4.6	-0.72	-0.17
65	3.6	2.1	3	1	4.3	-0.58	0.46
66	2.7	1.9	2	1	3.5	-0.72	0.74
67	5.7	2.2	6	5	4.6	-0.71	-0.32
68	7.8	1.4	8	9	2.0	0.40	-1.04
69	6.9	1.8	7	9	3.3	-0.09	-0.70
70	7.5	1.7	8	9	3.0	1.16	-1.30

Questions	mean	SD	median	mode	variance	kurtosis	skewness
71	6.1	1.8	6	7	3.3	0.21	-0.66
72	6.8	1.5	7	7	2.2	-0.47	-0.32
73	7.3	1.5	7	7	2.1	3.43	-1.38
74	7.5	1.4	8	7	1.9	4.19	-1.43
75	7.2	1.2	7	7	1.4	-0.66	-0.01
76	6.8	1.3	7	7	1.7	-0.94	-0.13
77	7.4	1.4	8	8	2.0	3.06	-1.31
78	7.7	1.4	8	9	1.9	1.21	-1.18
79	7.8	1.3	8	9	1.8	4.40	-1.77
80	6.8	1.5	7	7	2.3	-0.24	-0.46
81	6.6	1.5	7	7	2.4	1.29	-0.80
82	7.0	1.7	7	7	2.9	0.85	-0.98
83	6.6	1.4	7	7	2.0	1.52	-0.71
84	7.3	1.7	8	8	2.8	2.26	-1.42
85	5.6	1.8	6	7	3.1	-0.03	-0.54
86	5.9	1.5	6	7	2.4	1.06	-0.92
87	6.6	1.5	7	7	2.1	1.18	-0.36
88	7.2	1.3	7	8	1.7	0.08	-0.67
89	6.5	1.4	7	7	2.1	0.62	-0.76
90	7.7	1.5	8	9	2.1	1.33	-1.32
91	8.0	1.2	8	9	1.5	2.43	-1.45
92	7.2	1.4	7	7	2.0	0.79	-0.86
93	7.2	1.4	7	7	1.8	2.76	-0.98
94	3.7	2.3	3	1	5.1	-0.88	0.39
95	4.3	2.4	5	1	5.9	-1.27	-0.13
96	6.8	1.7	7	7	2.8	1.32	-0.91
97	7.9	1.3	8	9	1.7	7.74	-2.23
98	7.3	1.2	7	7	1.5	-0.28	-0.37
99	7.1	1.5	7	8	2.3	0.49	-0.80
100	7.5	1.2	8	8	1.5	1.15	-0.95
101	7.3	1.4	8	8	2.1	0.51	-0.91
102	7.8	1.3	8	8	1.6	1.47	-1.20
103	7.1	1.4	7	7	2.0	0.62	-0.75
104	7.2	1.3	7	7	1.6	0.43	-0.64
105	6.6	1.6	7	7	2.6	-0.21	-0.45
106	6.3	1.8	7	7	3.2	0.33	-0.79

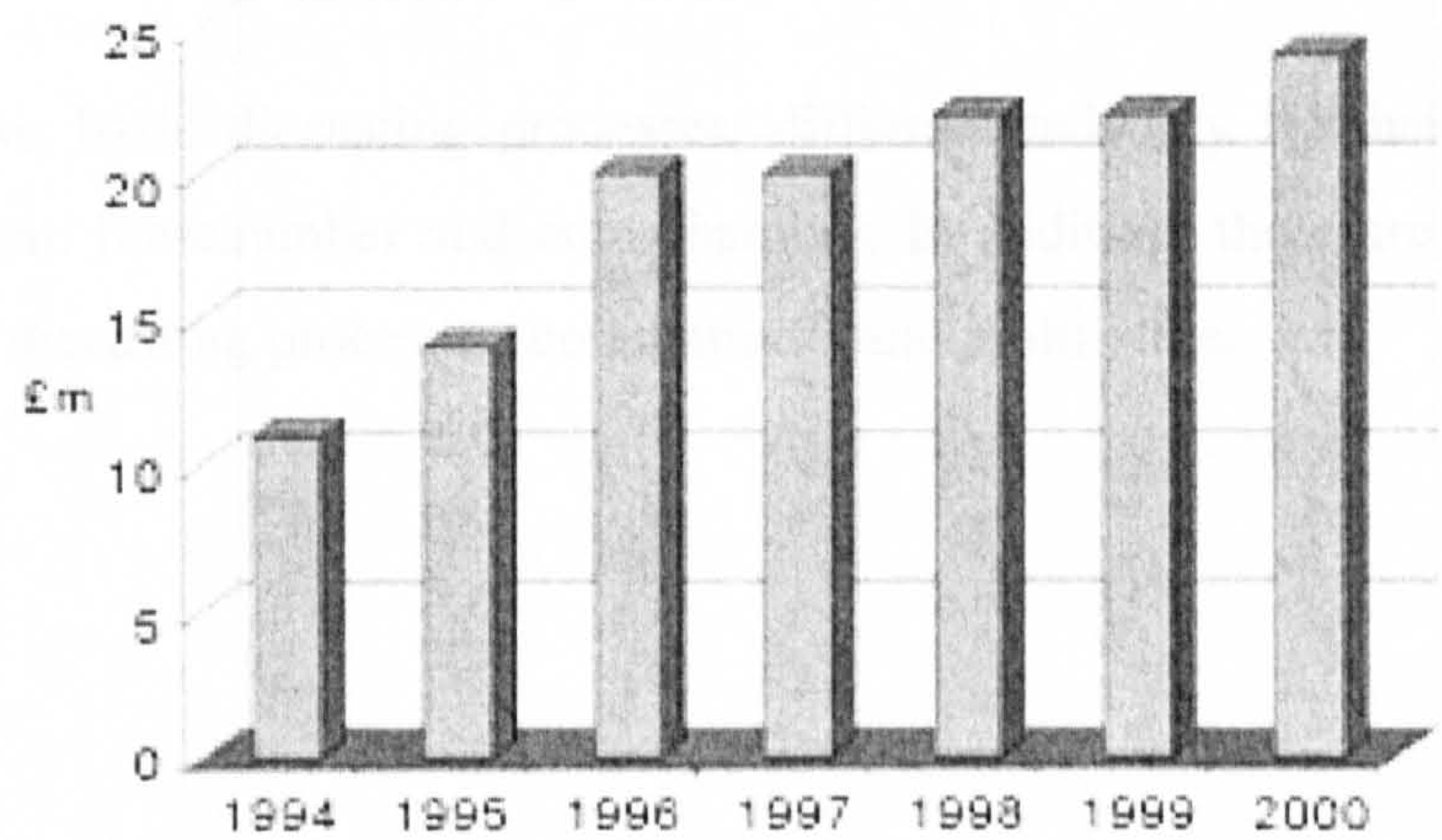
Appendix D: Background of Selected Companies in the Evaluation of the Methodology

COMPANY A: WHSmith (Tools) Ltd

At the opening of the 21st century, WHS has already shown that being proactive in the traditional world of injection moulding technology can bring measurable benefits to customers. WHSmith is using the latest, leading edge techniques available. In the face of increasingly stiff competition from overseas producers, their integrated combination of tailor-made, mix and match services has proved highly successful.

- Number of People: 400
- Number of moulding machines: 95
- Range of moulding machines: 20 - 500 tons
- Production: 24hrs x 7days/week

WHSmith (Tools) Ltd Annual Sales:



COMPANY B: PRESBAR DIECASTINGS Ltd

Presbar Diecastings Ltd has long been regarded as a major force in the Aluminum Pressure Diecasting Industry. The "State of the art" equipment at Presbar, for both Diecasting and Machining, has led to achieving un-paralleled productivity, and low reject levels. This enables Presbar to operate at a lower true cost than it's competitors, and offer the cost savings on to its customers. The revenue is around GBP 5M / annum. The total number of employees is between 30 and 40.

The well motivated and enthusiastic management team has a culture of customer focus, adherence to schedule and continuous improvement in all areas. Presbar are committed to providing the very best in diecasting service, from initial design concept, through to supplying correct, fully finished items. The traditional diecasting process may be described as the injection under high pressure into a steel mould (otherwise known as a tool or die) of a molten metal alloy. This solidifies rapidly (in a few seconds) to form a net-shaped component, which is then automatically extracted.

The majority of zinc components, and non-ferrous components in general, are produced by the high-pressure diecasting process. Other casting processes include gravity casting and investment casting, suitable for low volumes or materials with very high melting points.

There are two basic diecasting processes, differentiated only by their methods of metal injection: hot-chamber and cold-chamber. In addition, there are two types of hot-chamber diecasting processes: conventional and multi-slide.

COMPANY C: FIFE FABRICATIONS LTD

Fife Fabrications supply precision sheet-metalwork, electro-mechanical assemblies and precision engineered components to a global market. They are recognised as a "Concept to Component Provider" to OEM's & EMS 's worldwide.

Through their continued investment in facilities and leading edge equipment, their 106,000-sq.ft facility houses a very advanced manufacturing site. This includes in-house capability in areas of Punching, Laser, Forming, Welding (Mig/Tig), Alochrome , Paint (Wet/Powder and Waterborne), Silk-Screen, Electro-Mechanical Assembly and Precision Machined Components . The turnover is in excess of £7 million pounds and around 140 employees. Accredited to ISO9000:2002, ISO14001 and IIP.

Fife Fabrications Limited is based in Glenrothes and was formed in 1972. The company received BS5750 approval in 1986, BS EN ISO 9002 in 1995 which we have now successfully upgraded to ISO9001:2000. They are one of the UK's most advanced manufacturers of precision sheet-metalwork, electro-mechanical assemblies and precision machined components.

FiFab supplies components and assemblies to sectors within the instrumentation industry, power generation industry, defence industry, ATM market, telecommunications industry and security market along with may other sectors. Fifab has grown into a World Class Manufacturer, with global sales. Currently, 50% of their sales are outside Scotland. Fifab services markets within the UK, Germany, Malaysia, China and the USA. FiFab supplies OEM's & EMS's world-wide with quality, on-time products at competitive prices.

Appendix E: Evaluation Questionnaire

SMI Implementation Methodology

EVALUATION INTERVIEW

1. FEASIBILITY

Could the methodology be followed?

____

____

2. USABILITY

How easily could the methodology be followed?

____

____

3. USEFULNESS

Would the methodology provide an output that met users' expectation?

____

____

4. How would you improve this methodology?

____

____

5. What do you consider to be the strengths of this methodology?

____

____

6. What makes this methodology different from other methodologies that you have used?

____

____

Appendix F: Application of the Workbook

CONTROL TECHNIQUES

STRATEGIC MANUFACTURING INITIATIVE

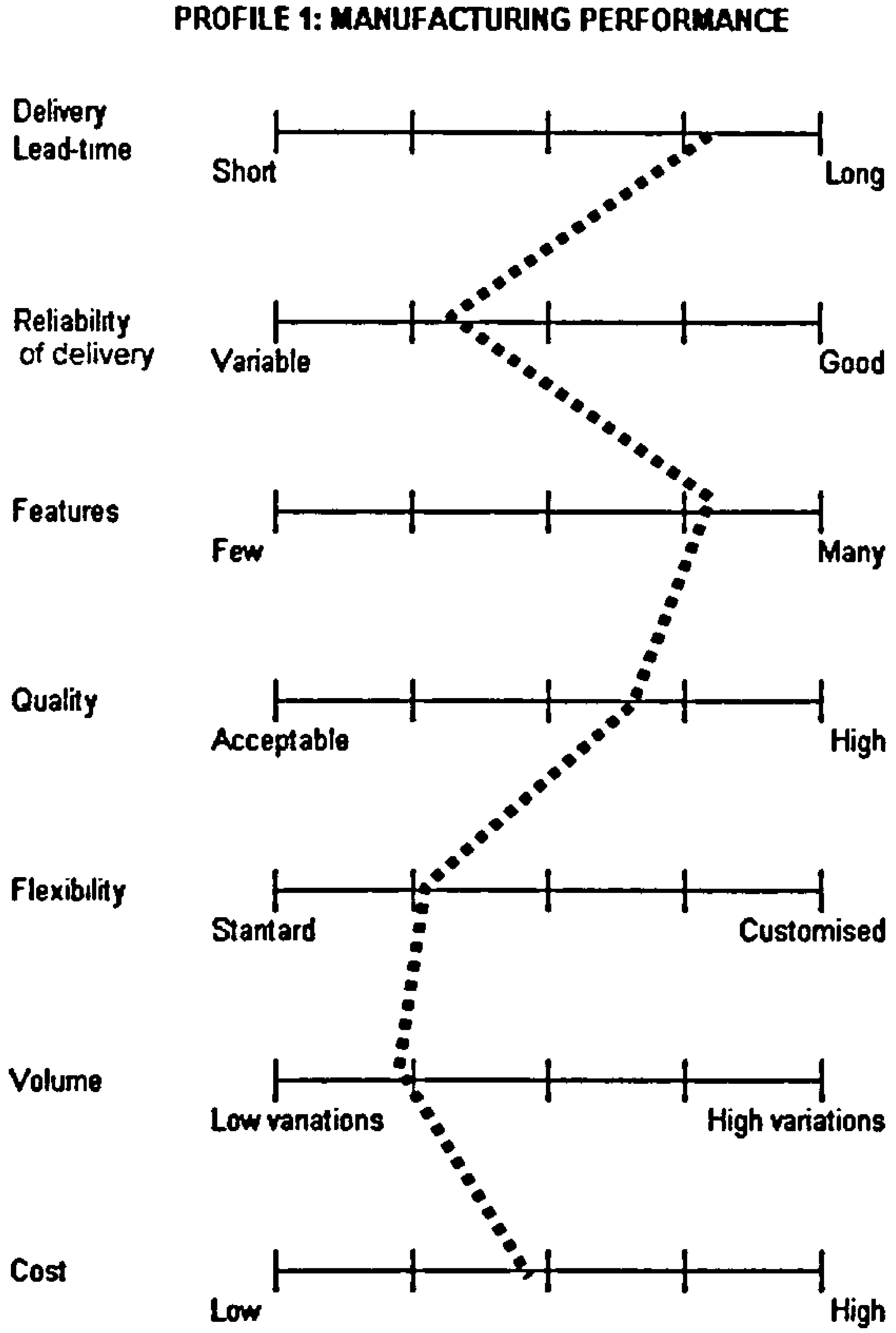
IMPLEMENTATION

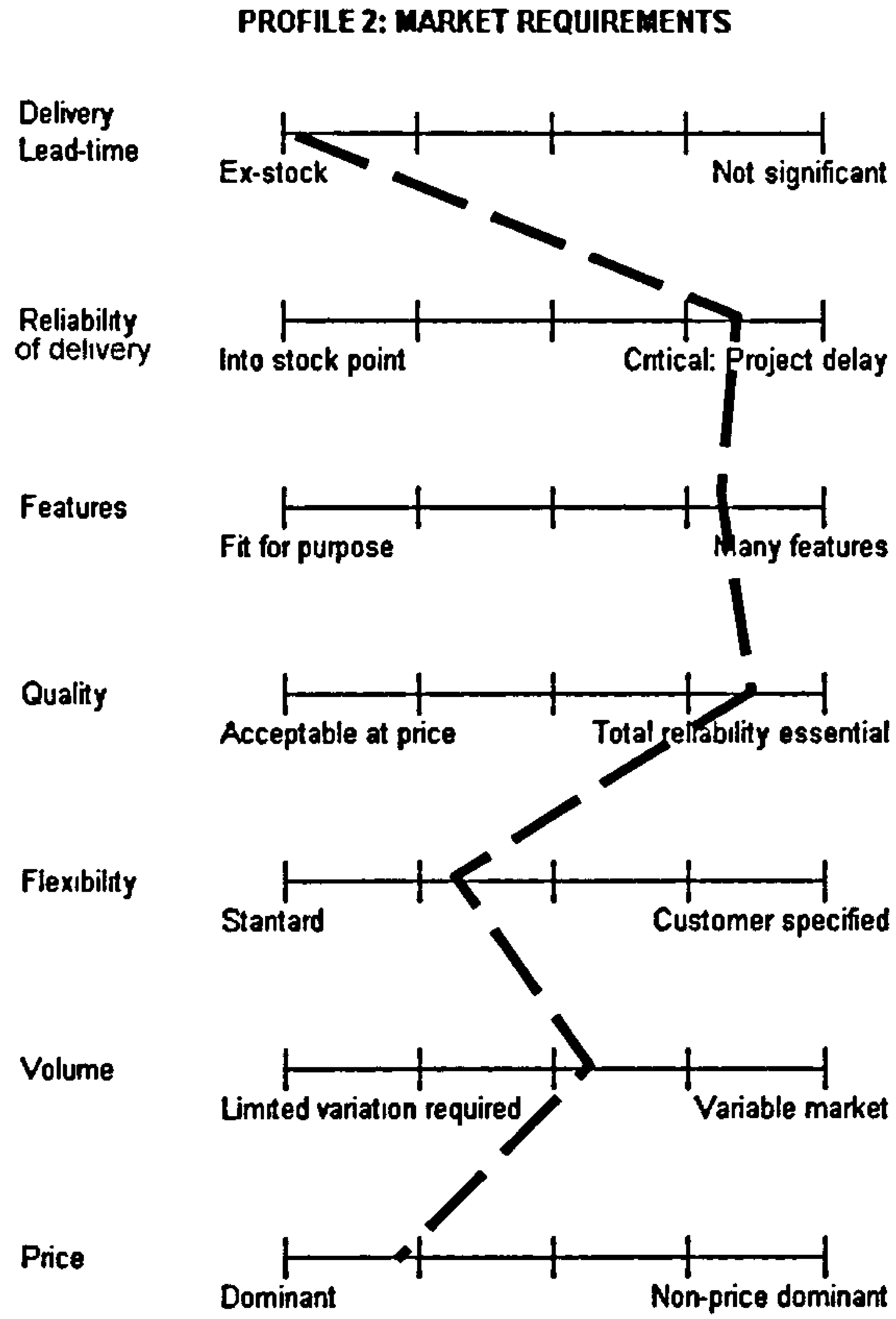
DEVELOPMENT AND INTEGRATION OF
DEMAND **L**ED **D**ISTRIBUTION PRINCIPLES
INTO THE OPERATIONAL PROCEDURES OF THE
MANUFACTURING PLANT

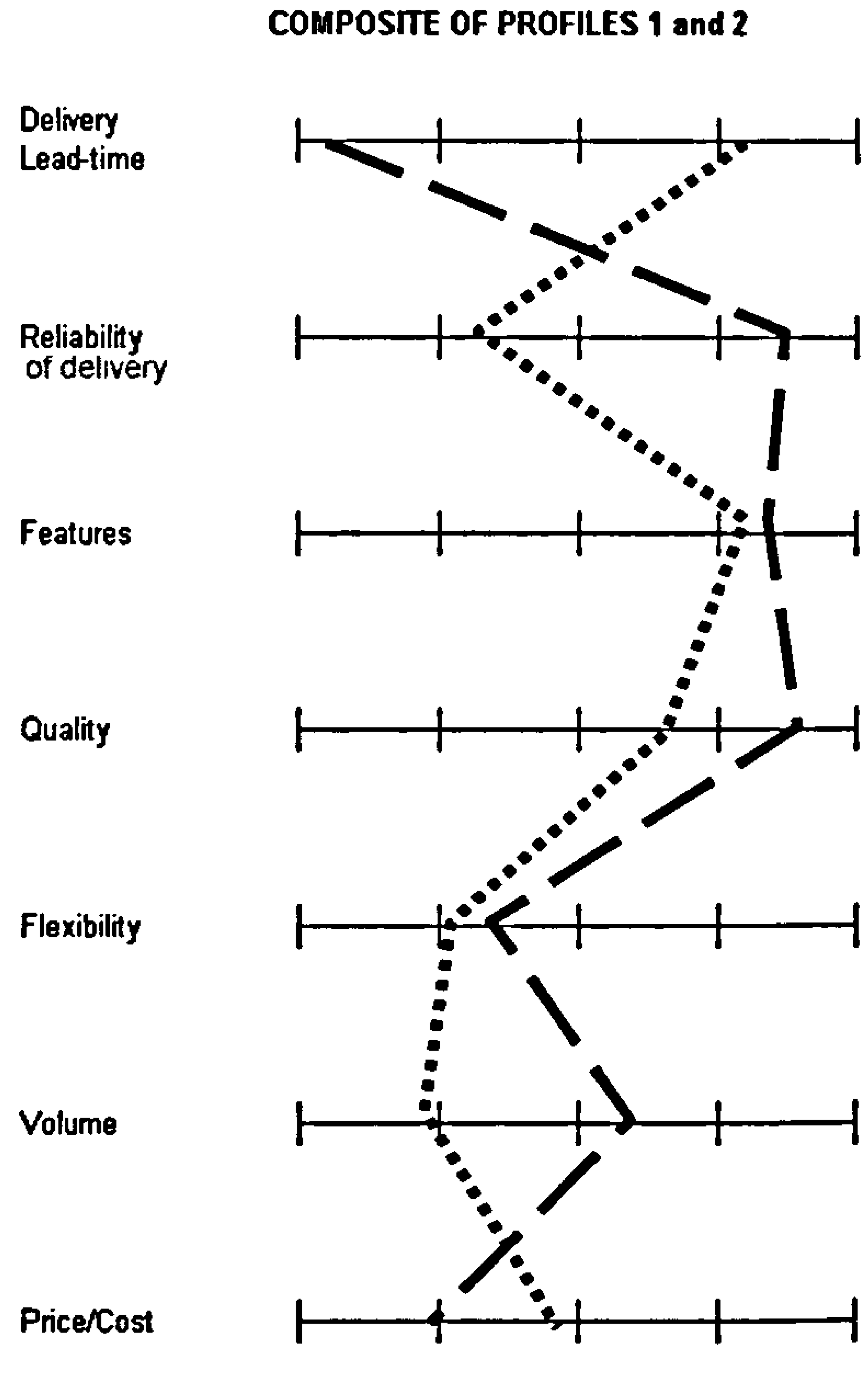
Last update: 27th July 2004

Contents

Strategic Analysis and Benefits







Strategic analysis and benefits explained

Gaps between CT Strategic Manufacturing Capabilities and Market Requirements targeted:

1. **Delivery Lead Time.** Our Customers/Drive Centres expect and need immediate delivery (0 lead time) of orders in order to maintain existing customers and above all to be able to grow and acquire new customers. Currently we are providing anything up to 6 weeks lead time.
2. **Reliability of Delivery**. Customers/Drive Centres plan their projects based on our promised delivery date. This date is critical for them as they have to plan all their resources around projects. Bad reliability of delivery means loosing business. Even when we promise a delivery date to a customer we still fail to achieve 25% of the times.
3. **Volume and mix requirement changes.** The mix of products that the market demands is variable over short periods of time. Manufacturing must be capable of coping with these changes while carefully controlling and managing the inventory figure.

3

Key Performance Objectives

1. To reduce Sales Orders Lead Time.
Measure: Lead Time (days)
Target = Next Day Delivery of high volume product ratings and 10 day lead time for low volume product ratings. Currently we are offering up to 6 weeks lead time for high and low volume product ratings.

2. To reduce Sales Overdue value.
Measure: Dollar Days Overdue.
Target: Not Defined

Financial Benefits

Not included (CONFIDENTIAL)

Estimated Duration (Timescale)

The whole project is intended as a learning activity for the organisation and an opportunity to identify the right changes to further meet and exceed our customers' demands and expectations.

Nevertheless, key performance measures have been identified and a formal review by the steering group will take place (26th July 2004)

Project Team

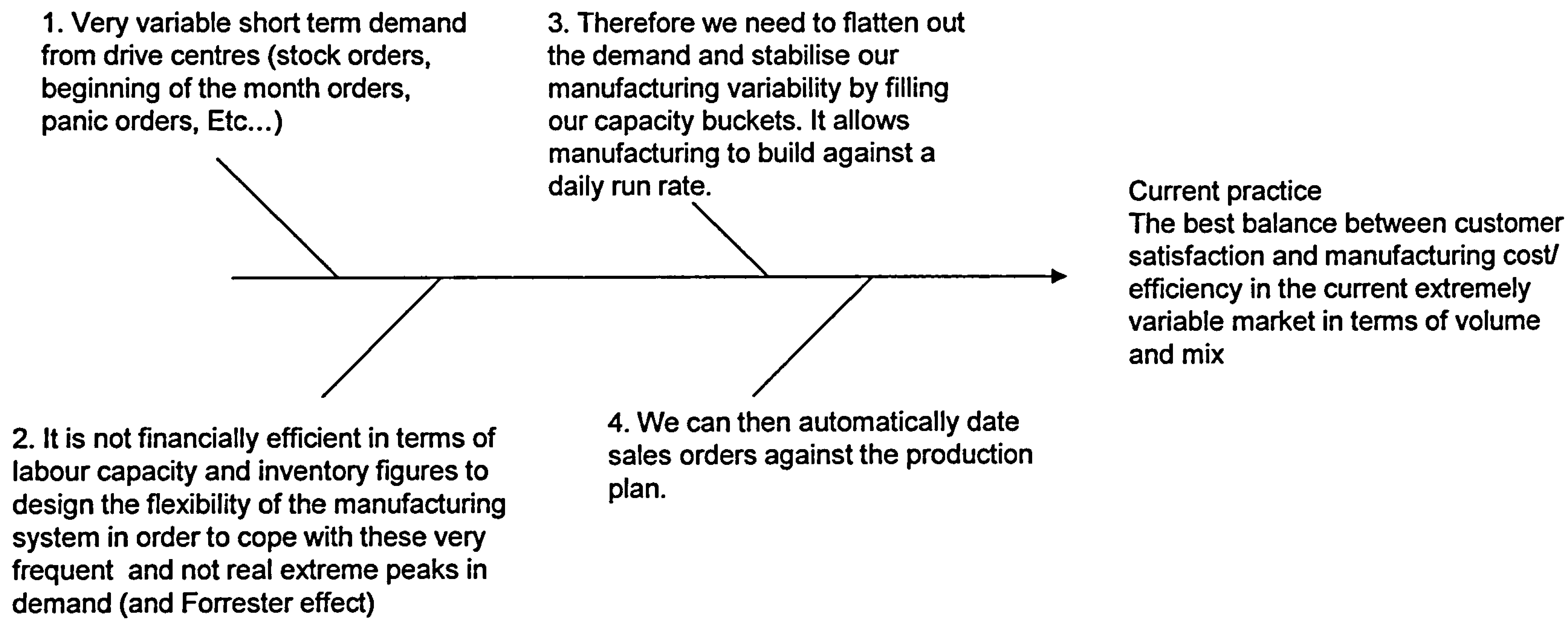
PROJECT MANAGER: PETER EDWARDS

PROJECT TEAM:

1. MICHELLE SIM
2. BARBARA WIGLEY
3. JEAN WELLS
4. JAMES BOOTH
5. MALCOLM NEWBERRY
6. JULIE BURNS

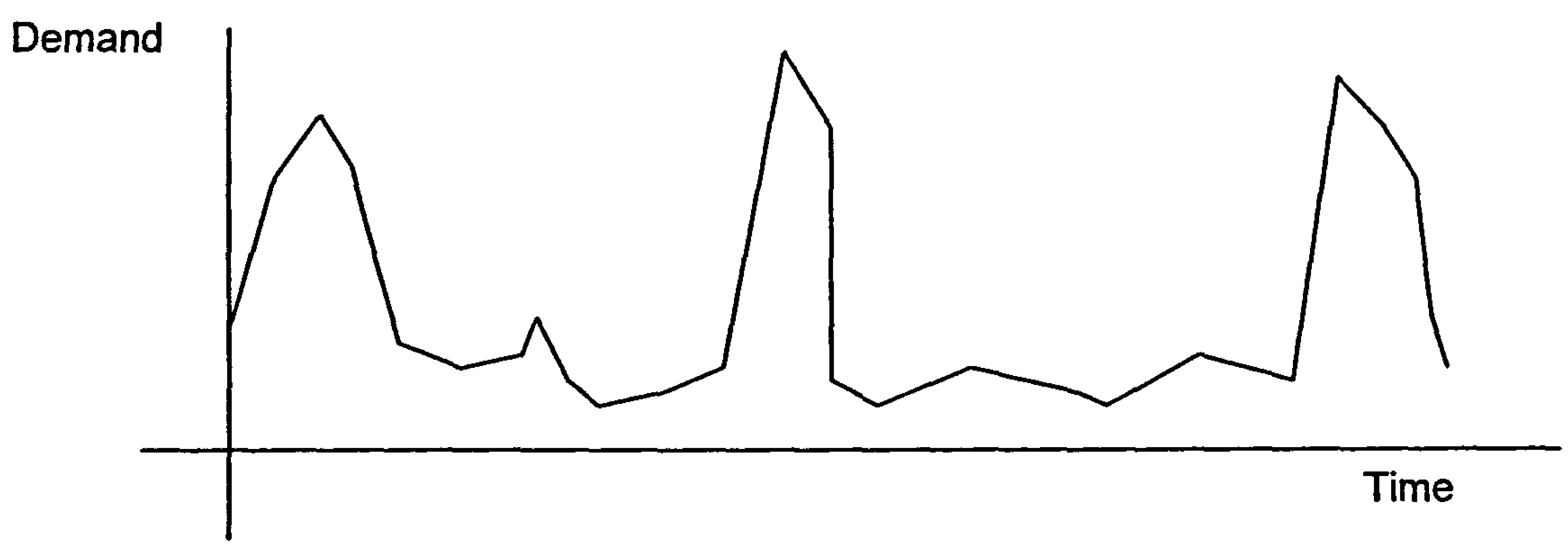
SMI Diagnosis – Current Practice

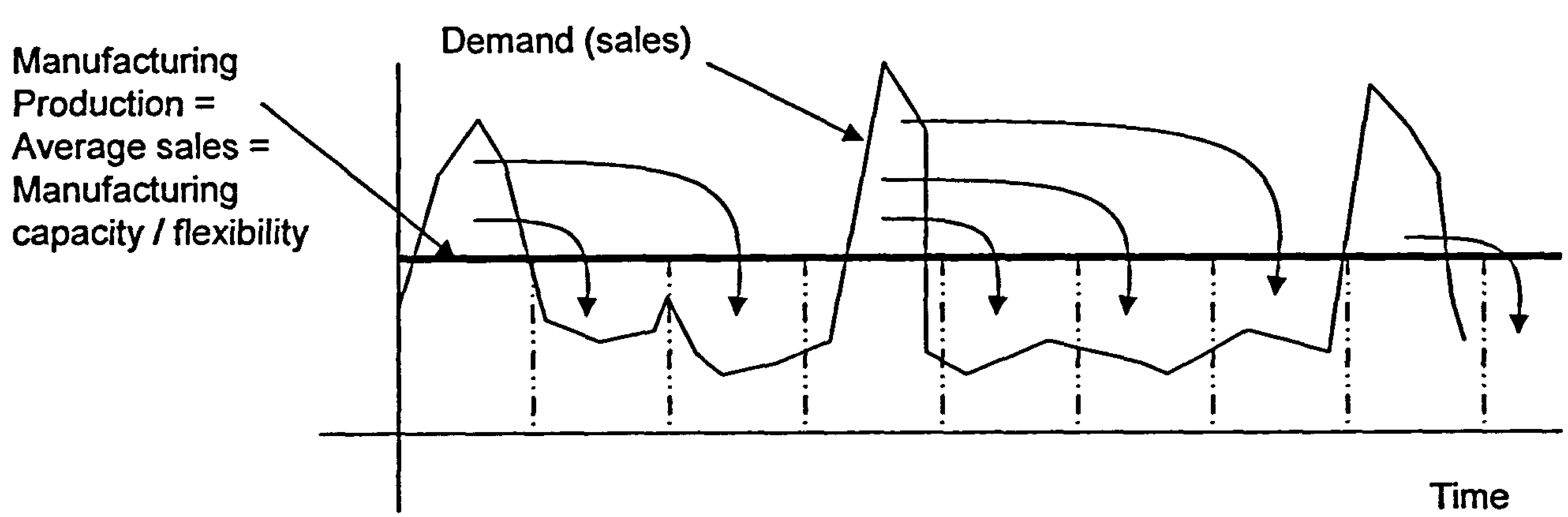
Fishbone analysis - Why the current practice is the way it is



SMI Diagnosis – Current Practice

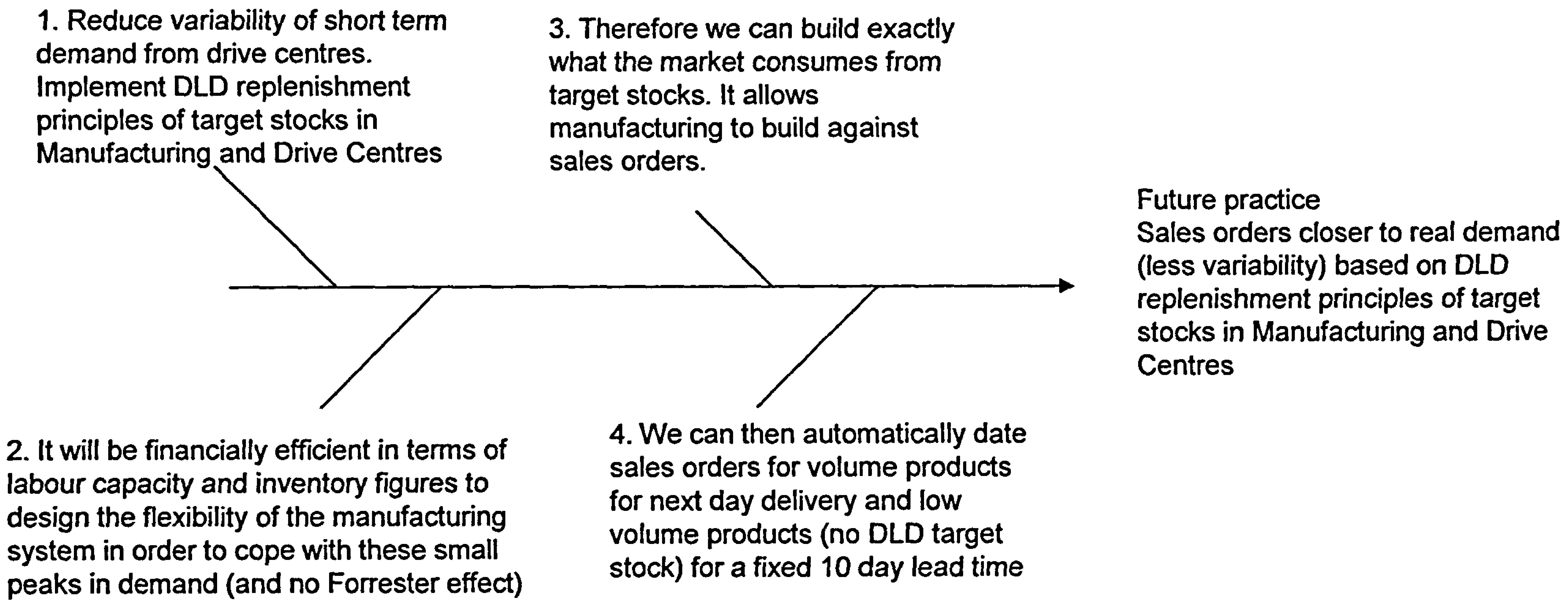
Fishbone analysis - Why the current practice is the way it is





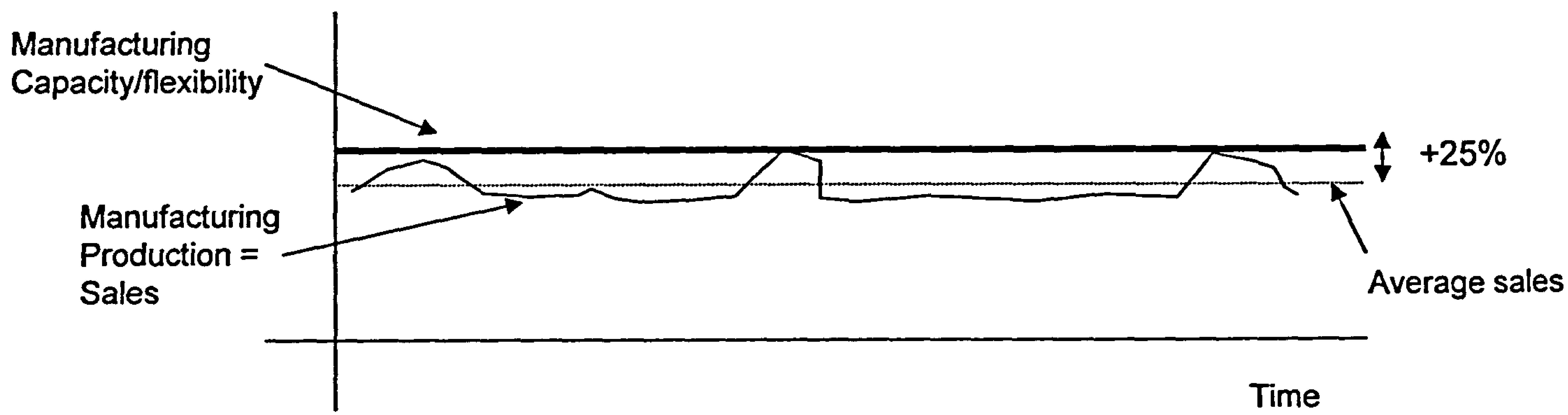
SMI Diagnosis – Future Practice

Wishbone analysis - Factors/conditions to fulfil new practice



SMI Diagnosis – Future Practice

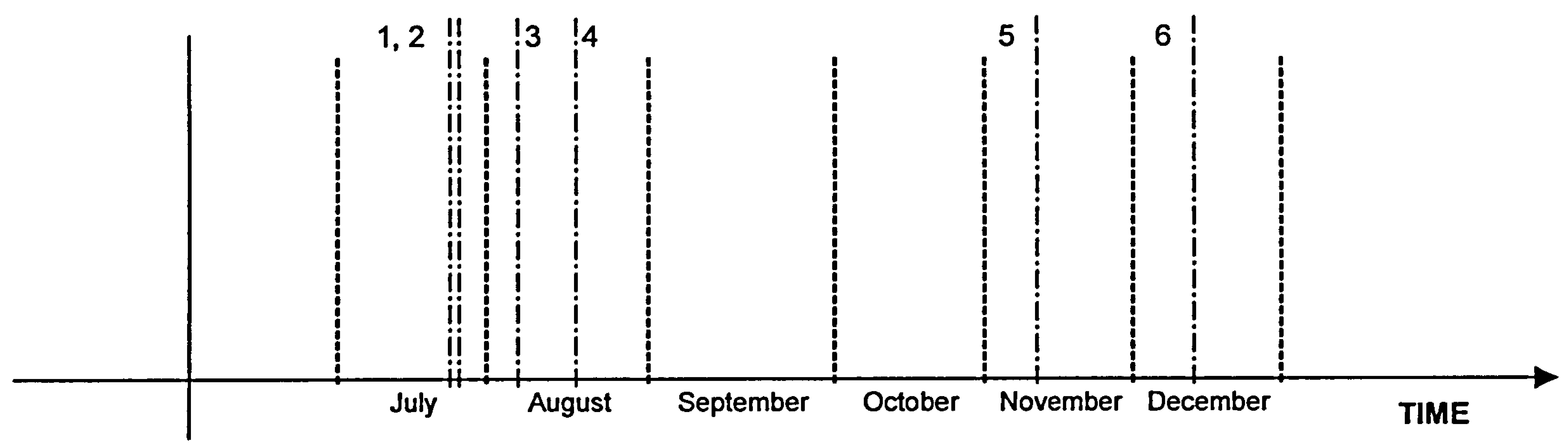
Wishbone analysis - Factors/conditions to fulfil new practice



Milestones

Project milestones	By when?
1 Team and production management formed	26-Jul
2 Uni 1 starting operation under DLD	26-Jul
3 Present Uni 1&2 Supplier countdown for readiness - giving date of last supplier to be completed and all agreements reached. (method of Supply MOQ etc...)	09-Aug
4 Uni 2 Operating DLD - 18-Aug-04	18-Aug
5 SP1&2 operating under DLD by Nov-04.	Nov-04
6 SP3&4 operating under DLD by Dec-04.	Dec-04

Gantt Chart - MILESTONES



Activities

How-How analysis

Responsibilities

	Project Team Member
Activity 1	EV
Activity 2	EV
Activity 3	EV
Activity 4	PE / EV

	Project Team Member
Activity 5	EV / EM / DP
Activity 6	EM / DP

Project Plan

DLD PROGRAM FOR UNIDRIVE CLASSIC SIZES 1 AND 2

Enrique Viseras
19-Jul

	MILESTONES		Status	Resp.	Date	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul	01-Aug	02-Aug	03-Aug	04-Aug	05-Aug	06-Aug	07-Aug	08-Aug
UNIDRIVE CLASSIC SIZE 1	1	Understand and develop the current DLD principles and establish the working practices of	COMPLETED	EV	12-Jul																															
	2	Define supplier delivery flexibility and operational system	COMPLETED	EV	12-Jul																															
	3	IT / MK modifications required	OPEN	PE/DL	26-Jul																															
	4	Brief the operational procedures to Production and Engineering	COMPLETED	EV	14-Jul																															
	5	Brief the operational procedures and principles to upstream processes	OPEN	DP/EM	Sep																															
	6	Define cell performance measures and targets	OPEN	EV/DL	20-Jul																															
	7	Brief the operational procedures and principles to Senior Management	OPEN	DL	20-Jul																															
	8	Correctly size in-process kanbans	OPEN	EV	19-Jul																															
	9	Correctly size supplier kanbans	OPEN	DP/EM	Sept																															
	10	Brief the operational procedure to cell team members	OPEN	EV	26-Jul																															
	11	Phase 1 - UNI 1 production under DLD operating practices	OPEN	EV	26-Jul																															
	12	Phase 2 - UNI 1 production under DLD production and supply practices	OPEN	EV	04-Aug																															
UNIDRIVE CLASSIC SIZE 2	13	Brief the operational procedures and principles to upstream processes	OPEN	DP/EM	11-Aug																															
	14	Correctly size in-process kanbans	OPEN	EV	13-Aug																															
	15	Correctly size supplier kanbans	OPEN	EV/DP	Sept																															
	16	Brief the operational procedure to cell team members	OPEN	EV	18-Aug																															
	17	UNI 2 production under DLD production and supply practices	OPEN	EV	18-Aug																															

Communication Plan

Action	Who	When	What
DL/EV	SENIOR MANAGEMENT	20-Jul	DLD Manufacturing working rules and principles
EV		22-Jul	Create document "Contents of the Communication"
EV/CD		22-Jul	Agree document "Contents of the Communication"
EV/CD		22-Jul	Agree First Draft of Structure reporting to Enrique
CD/EV	Wayne / Michelle	23-Jul	"Contents of the Communication" Discuss First Draft of Structure reporting to Enrique Agree Final Structure reporting to Enrique
EV	Michelle	23-Jul	Explain DLD principles and next steps
CD	Employees including engineers, mat. Handlers, builders, ...	23-Jul	"Contents of the Communication" Final Structure reporting to Enrique starting 26th July
EV	Team UNI1 & 1	26-Jul	Explain DLD principles and next steps
DL/EV	FORUM	Aug	Explain DLD principles and next steps

"Contents of the Communication"

1. CT has started a new distribution and inventory replenishment system from Drive Centres to End Customer, and from Unit79 to Drive Centres. This process is called Demand Led Distribution (DLD) and in these early stages it is proving very successful in terms of improving customer satisfaction, on-time delivery and reduction of sales orders lead times.

2. The next stage of the development of the process is to understand, adapt and integrate the DLD principles to the operational procedures of the Manufacturing Plant (Unit 79). This process is new for all of us and we have identified a need for additional and focused resources.

3. In this context, Enrique has been seconded from his role as Engineering Manager in the PCB Plant to Production Manager in the Module Plant responsible for Unidrive Classic Sizes 1 and 2.

4. Therefore, a team of people will be seconded to work with Enrique, to help him and CT to understand and develop these new principles. These people will report to Enrique until further notice.

5. As we have said, these changes are by no means any kind of punishment to the current performance of the module plant, it is just adding additional resources to develop and integrate the DLD system in our working practices.

6. We ask you for your full collaboration in this initiative and a very active contribution to make it successful

Technical documentation

1. MANUFACTURING WORKING PRACTICES

2. UNI 1 – MPS Changes to achieve DLD Target Stocks from current zero stock situation plus sales overdue bubble considering Supply Chain flexibility limitations

3. First Draft of Manufacturing Team basic information for decision making

MANUFACTURING WORKING PRACTICES

CUSTOMER

1 Unit 79 Target quantity (DLD stock) is reviewed every month
Unit 79 Target quantity (DLD Stock) is calculated based on excel simulation based on historical demand (careful consideration to exceptions)

2 Average sales are reviewed every month
MPS equals 1.25 times the average sold of each rating including all variants (DLD and non DLD)

3 Sales are despatched from DLD stock (next day delivery)

4 New Work Orders by rating and variant are created daily based on reduction of DLD stock.

5 Total quantity of units in work orders = Target quantity - DLD stock + Ordered quantity

6 Work Orders are dated based on the following rules

DLD Product	Stock	3 days
	Zero Stock (Sales orders)	Dated based on maximum daily production based on 1.25 average sales (MPS) using the ATP tool

Non DLD product (Zero stock) Sales orders	10 days fixed lead time Initially dated based on maximum daily production based on 1.25 average consumption (MPS) using the ATP tool

1/3

MANUFACTURING WORKING PRACTICES

MANUFACTURING

1 Manufacturing will prioritise work orders based on date order and traffic lights system

2 The target is to produce all today's work orders

3 No work orders = No production. Work orders are only created against reduction in Target stock as a consequence of a sale despatched
There are no work orders created against MPS.

4 In order to not to create a very disruptive and probably critical gap in the Supply Chain, the cummulative weekly production of each rating including all variants (DLD and non DLD) should not exceed 1.25 x average sales (MPS)

5 Past overdue work orders and work orders (sales) up to three days from today will be visible to Manufacturing in order to plan resources and production

6 All support departments/functions (Engineering/Technical/Test/IT) will give priority 1 to all activities that will keep production stops below 1 day

2/3

MANUFACTURING WORKING PRACTICES

SUPPLY CHAIN

1 MPS published equals 1.25xAverage sales. This way we ensure supply of material that will allow us to increase our production by rating/variant by a maximum of 25% daily.

2 Supply agreements based on lead times to supply 1.25 average sales through, ideally, a multibin Kanban system will be in place

3 Manufacturing's production does not exceed 1.25 x average sales. Therefore, demand on the supply chain will not exceed the published forecast (= 1.25xaverage sales)

4 Average sales are reviewed every month. Changes will be visible through the vendor schedule forecast
Suppliers should contact CT if they are not capable of supporting the new demand as soon as they received the vedor schedule forecast

5 PCB In-Process Kanbans will be set out based on 1.25x average sales with a lead time equal to 2 days

6 If a part has not been delivered to Unit79 on the delivery date then:
- 6.1 Same day delivery / air freight will be applicable at supplier's expense
- 6.2 Supplier is aware of the disruption created to our supply chain and the damage provoked to our customers. Therefore, penalties will be agreed and they will be contractual.

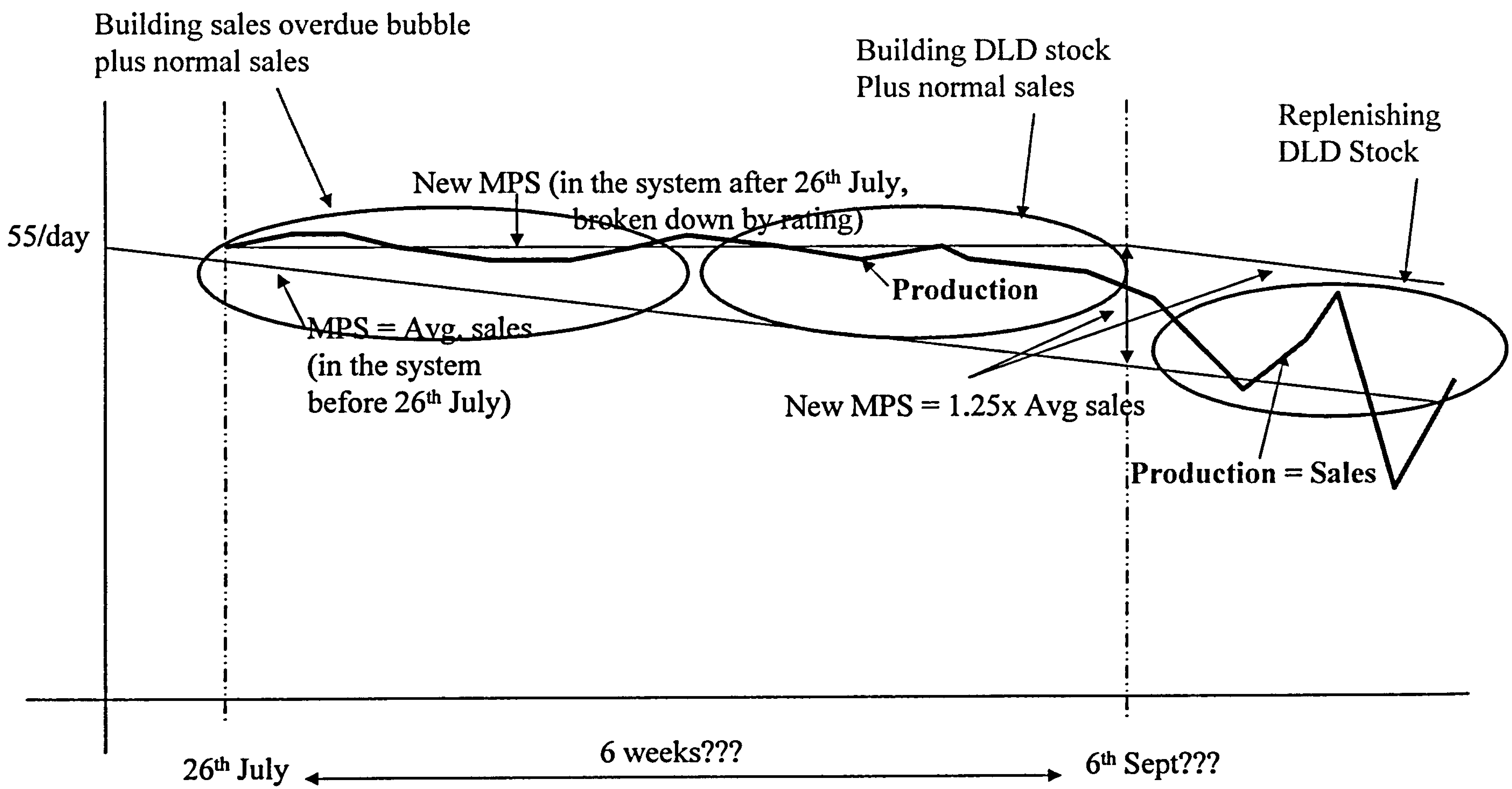
NOTE:
The 25% flexibility created in our manufacturing capacity and flexibility by product rating means that:

1 We can set clear rules to our Supply Chain (what we expect from them and what they can expect from us)

2 We can define the manufacturing system to cope with demand variability limited by supply chain flexibility = 25% above average sales

3/3

UNI 1 – MPS Changes to achieve DLD Target Stocks from current zero stock situation plus sales overdue bubble considering Supply Chain flexibility limitations



First Draft of Manufacturing Team basic information for decision making

		TARGET						SALES (DLD STOCK TARGET REDUCTION + SALES OVERDUE + SALES ORDERED)																	
	Description	STOCK	STOCK	Avg	Max	PLAN	PCBs	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	26-Jul	27-Jul	28-Jul	29-Jul
15000002803000	UNI1202 STD	0	0	0	4		4						9									5				
15000002901000	UNI1203 STD	0	0	0	4		1								1							1				
15000002903000	UNI1204 STD	0	0	0	4		4																			
15000003001000	UNI1205 STD	0	0	0	4		2																			
15000003003000	UNI1401 LER	0	0																							5
15000003101000	UNI1401 STD	110	1	7	9		62										12				3	2		10		9
15000003103000	UNI1402 LER	0	0																							2
15000003201000	UNI1402 STD	49	12	3	5		12						5					5				12				
15000003203000	UNI1403 LER	0	0																							4
15000003223010	UNI1403 STD	99	10	6	8		68									1	10	10				12		12		8
15010402803000	UNI1404 LER	0	0																		10					18
15010402903000	UNI1404 STD	286	2	11	14		179												3	41	10	13	13	19	12	4
15010403003000	UNI1405 STD	210	9	28	30		69														5	47	2	6	20	
15010403103000	UNI1405 LER	0	0																							
15010403203000	UNI1405 VTC STD	0	0																							
	Total							0	0	0	0	0	14	0	1	1	22	15	3	41	28	92	15	47	32	50
		TARGET						SALES (DLD STOCK TARGET REDUCTION + SALES OVERDUE + SALES ORDERED)																	
	Description	STOCK	STOCK	Avg	Max	PLAN	PCBs	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	26-Jul	27-Jul	28-Jul	29-Jul
15100003303000	UNI2202 STD		0		2		3	1																4		
15100003323010	UNI2203 STD		2		2		4																2			
15100003401000	UNI2401 LER		1																							
15100003403000	UNI2401 CTD		0				14																			
15100003423010	UNI2401 STD	100	144																4					5		
15100003433000	UNI2401 VTC STD		2																							2
15100003501000	UNI2402 STD	190	45				47										1				2		10	11		
15100003503000	UNI2402 CTD		0																							
15100003523010	UNI2402 LER		0																							2
15100003533000	UNI2402 LFT STD		0																							
15110403303000	UNI2402 VTC STD		0																							
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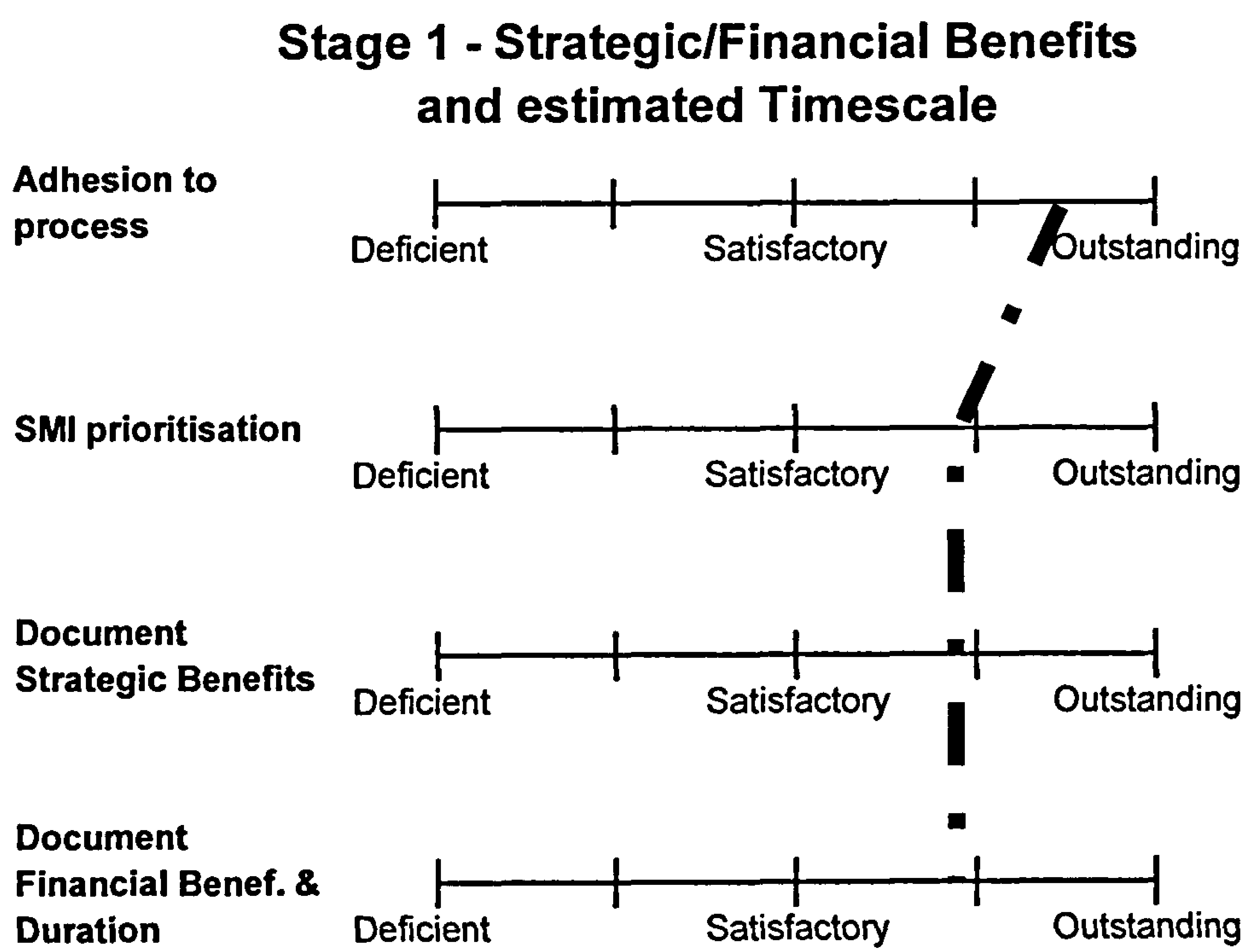
15110403503000	UNI2403 LER		0																							4
15110503303000	UNI2403 STD		42				23										2						2	5		
15110503403000	UNI2403 LFT STD		1																							
15110503503000	UNI2403 VTC STD		0																							
	Total							1	0	0	0	0	0	0	0	0	3	0	4	0	2	0	14	25	0	28
	Grand Total							1	0	0	0	0	33	0	4	8	25	15	7	41	98	64	29	72	32	78

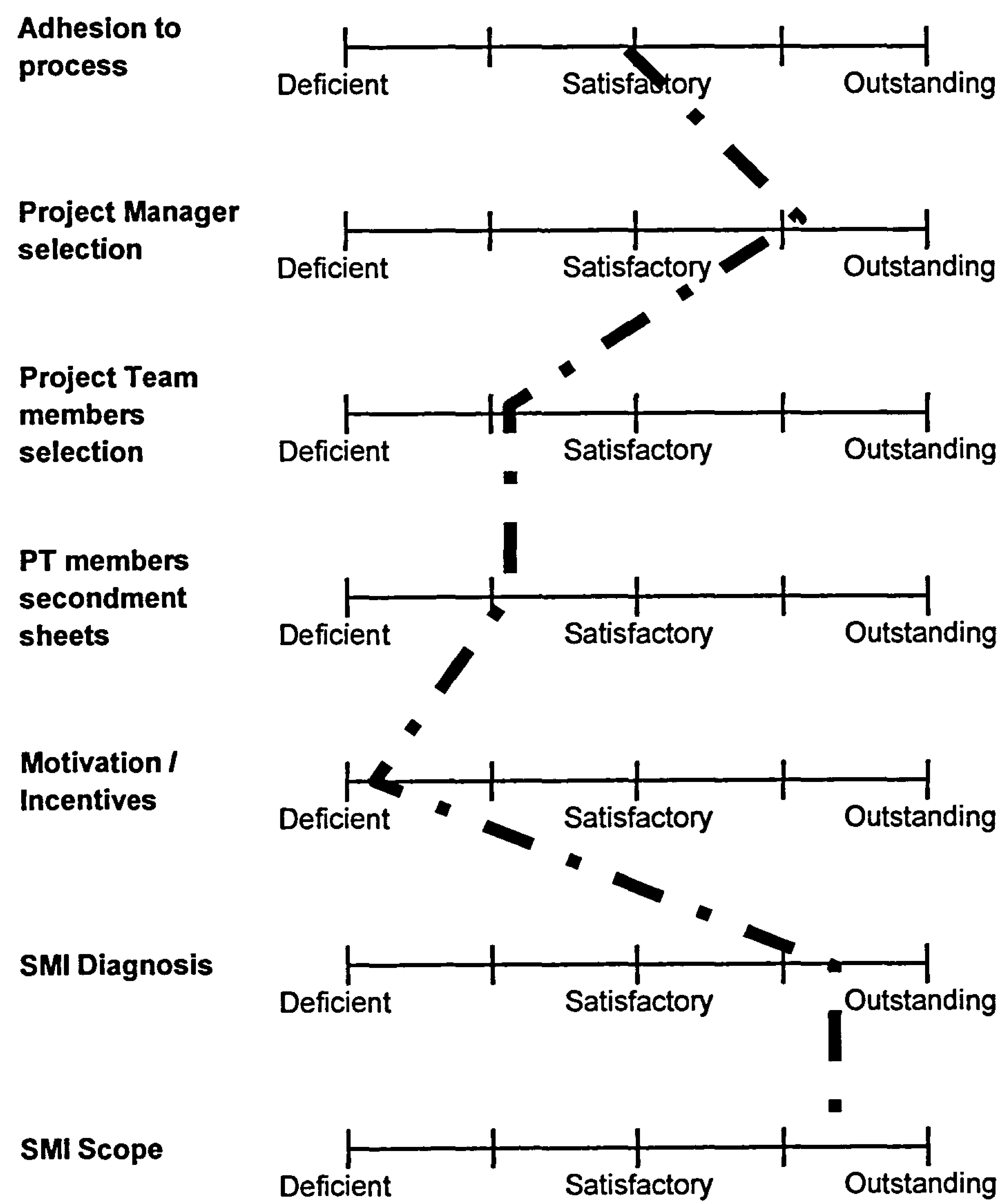
Appendices

Review Stage 1



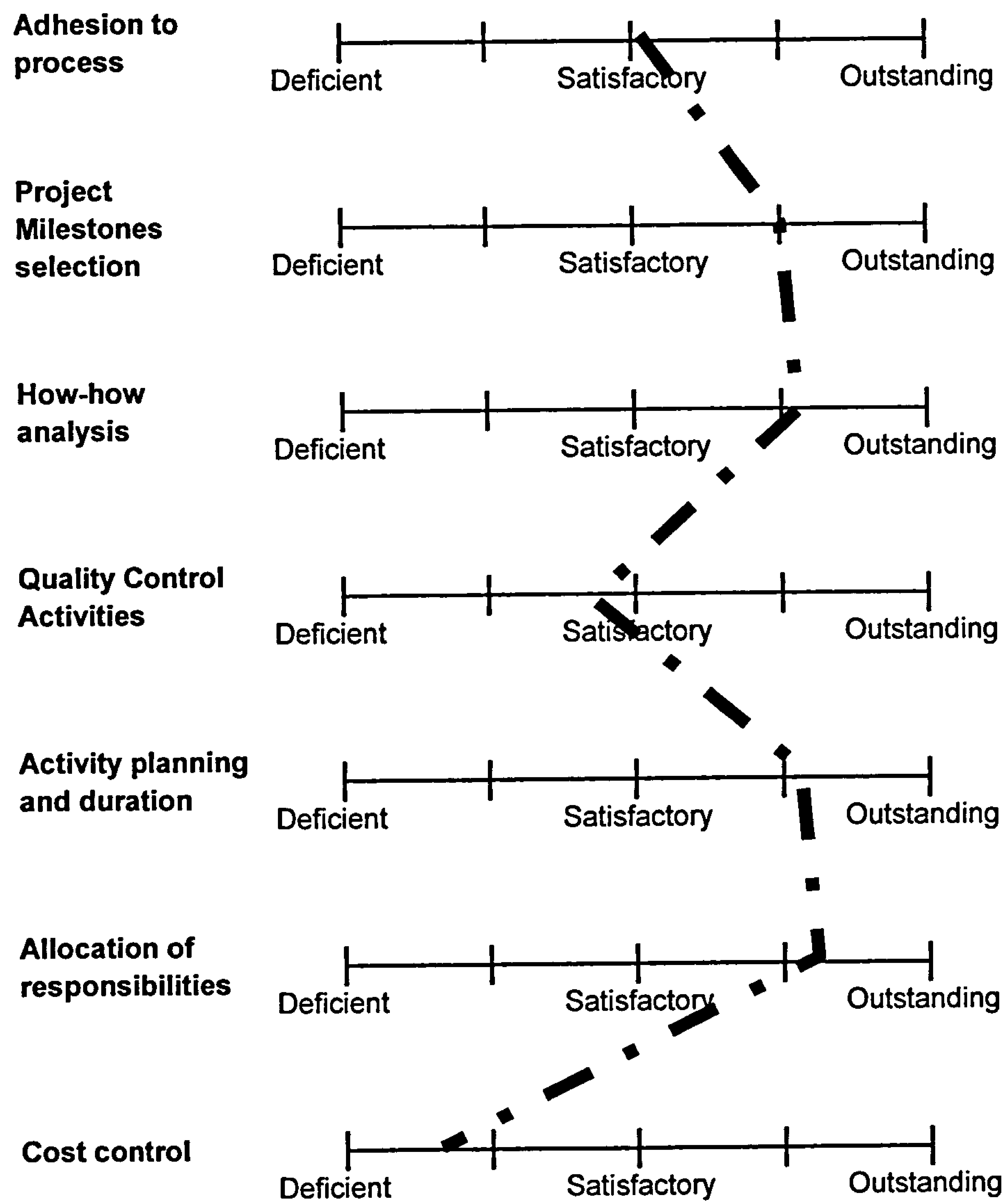
Review Stage 2

Stage 2 - Resources and Assessments of Benefits & Duration



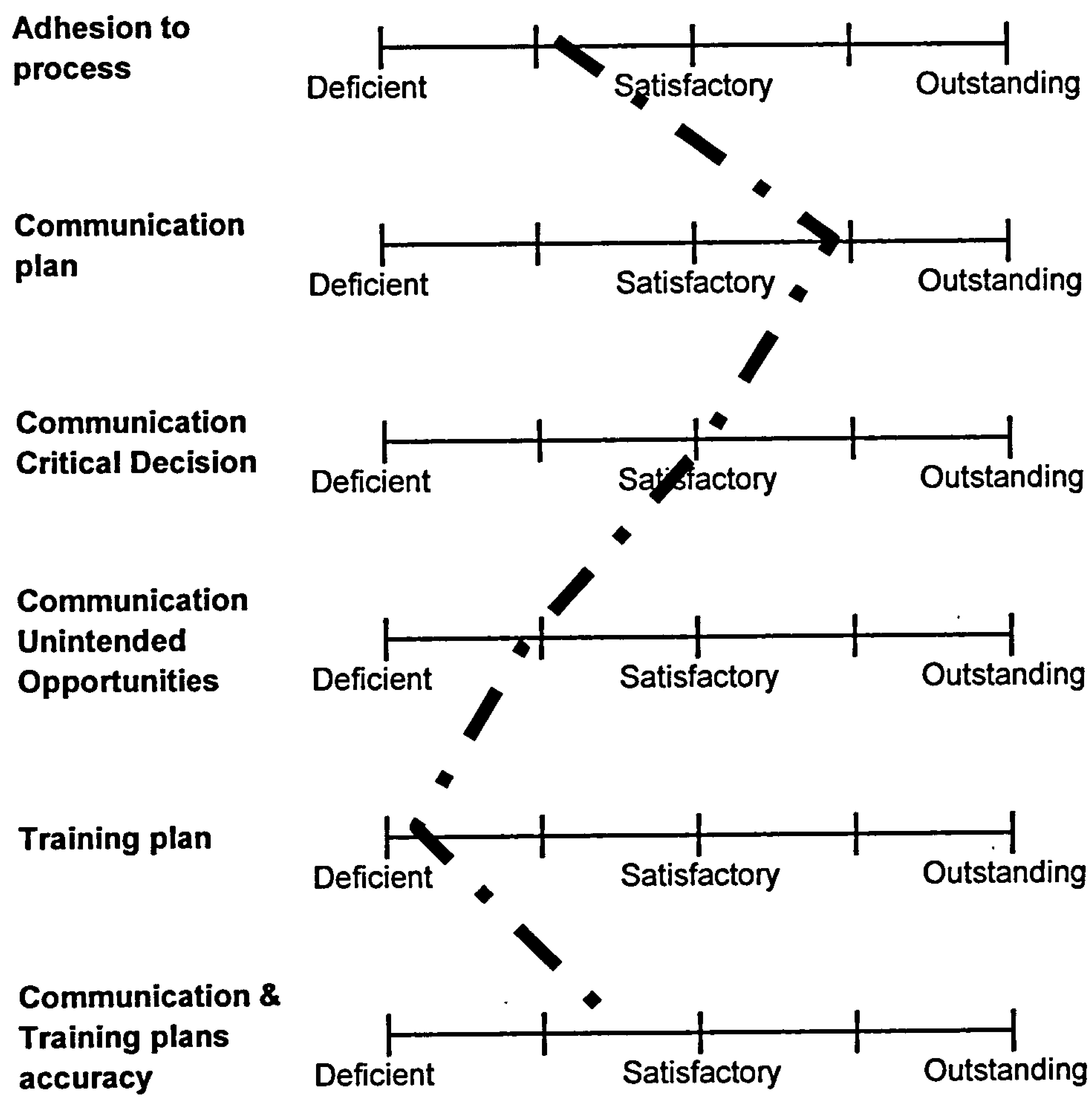
Review Stage 3

Stage 3 - Activities and Control



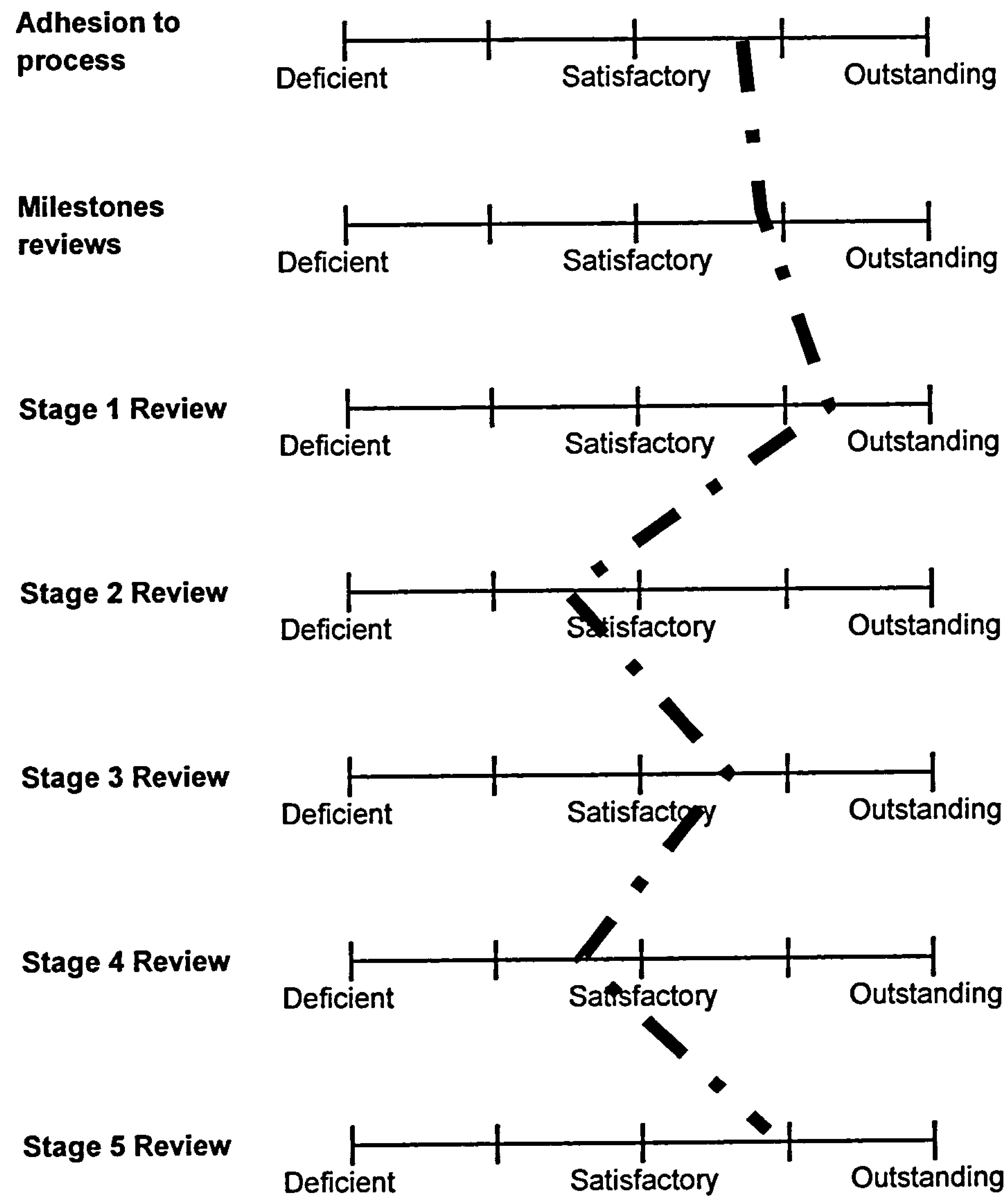
Review Stage 4

Stage 4 - Communication and Training Plans



Review Stage 5

Stage 5 - Review



Appendix G: Application Questionnaire

FEASIBILITY: COULD THE METHODOLOGY BE FOLLOWED?
Please tick the answer which corresponds to your opinion. Please add comments as necessary.

1. Were all the steps in the methodology completed?

No/Not at all ☐ Partly ☐ Don't know ☐ Mostly ☐ Yes ☐

Comments:...

....

2. Did the project follow the workbook methodology?

No/Not at all ☐ Partly ☐ Don't know ☐ Mostly ☐ Yes ☐

Comments:...

....

3. Was the methodology capable of coping with the different scenarios faced during the life of the project?

No/Not at all ☐ Partly ☐ Don't know ☐ Mostly ☐ Yes ☐

Comments:...

....

USABILITY: HOW EASILY HAS THE METHODOLOGY BEEN FOLLOWED?
Please tick the answer which corresponds to your opinion. Please add comments as necessary.

4. Did you find the stages and tools helpful?

No/Not at all ☐ Partly ☐ Don't know ☐ Mostly ☐ Yes ☐

Comments:...

....

5. Did you encounter any problems following the steps?

No/Not at all ☐ A few ☐ Don't know ☐ Many ☐ Too many ☐

Comments:...

....

6. Were any modifications made to the methodology?

No/Not at all ☐ A few ☐ Don't know ☐ Many ☐ Too many ☐

USEFULNESS: HAS THE METHODOLOGY PROVIDED AN OUTPUT THAT MET YOUR EXPECTATIONS?
Please tick the answer which corresponds to your opinion. Please add comments as necessary.

7. Did the project consume excessive resource of time and people?

No/Not at all ☐ A few ☐ Don't know ☐ Many ☐ Too many ☐

Comments:..
....

8. Was a successful output a function of using the methodology?

No/Not at all ☐ Partly ☐ Don't know ☐ Mostly ☐ Yes ☐

Comments:..
....

9. Would you use the methodology again?

No/Not at all ☐ Partly ☐ Don't know ☐ Mostly ☐ Yes ☐

Comments:..
....

CONTEXT: HAVE THERE BEEN ANY FACTORS INTERNAL OR EXTERNAL THAT MAY HAVE IMPACTED ON THE USE OF THE METHODOLOGY AND ITS OUTPUTS?
Please tick the answer which corresponds to your opinion. Please add comments as necessary.

10. Have you used a structured methodology previously?

No/Not at all ☐ Partly ☐ Don't know ☐ Mostly ☐ Yes ☐

Comments:..
....

11. Is there a flat or hierarchical organisational structure?

Comments:..
....

12. Have there been any recent changes in policies that may have impacted on the use of the methodology?

No/Not at all ☐ A few ☐ Don't know ☐ Many ☐ Too many ☐

Comments:..
....

Appendix H: Workbook Methodology for the Implementation of Strategic Manufacturing Initiatives

Cranfield UNIVERSITY

STRATEGIC MANUFACTURING INITIATIVES

IMPLEMENTATION WORKBOOK

Practical guidelines for the implementation of Strategic Manufacturing Initiatives

PREFACE

This strategic manufacturing specific project management methodology provides a consistent step by step discipline for implementing Strategic Manufacturing Initiatives and includes the tools, templates and techniques that reflect the distinctive nature of project management within the strategic manufacturing implementation area.

Our goal has been to produce a usable guide to organising the project management processes for the implementation of Strategic Manufacturing Initiatives. Therefore, this handbook does not replace formal procedures or experience, neither does it provide an exhaustive review of analytical techniques. Instead, it gives a structured, quick reference guide that will help practitioners to succeed in the implementation of Strategic Manufacturing Initiatives. In achieving this it helps the practitioner to:

- Prioritise Strategic Manufacturing Initiatives
- Formalise the Strategic Benefits, Financial Benefits and Duration of the Implementation project
- Select the Project Manager and Project Team Members and formalise their secondments and incentives
- Diagnose and Scope the Implementation Project agreeing Strategic/Financial Benefits, Special Resources and Duration of the project
- Define Milestones, Implementation Activities and Quality Control Activities
- Develop an Activity Plan and Time/Cost Control system
- Design Communication and Training plans
- Review the success of the project and the process of SMI implementation

TABLE OF CONTENTS

INTRODUCTION

The implementation of Strategic Initiatives in Manufacturing Organisations

Many companies are still facing major difficulties during the implementation of strategic decisions. Once a strategy has been developed, its implementation appears to be seen as a matter of operational detail and tactical adjustment carried out within the boundaries of existing structures and procedures. Practitioners need efficient methods of managing the successful and rigorous implementation of strategies in the manufacturing sector. A project oriented approach has been identified as an efficient process to manage strategic changes.
The implementation of projects strategically highly relevant to the manufacturing organisation is often undertaken by non-professional project managers. Often such people struggle to find an appropriate integrated methodology that contributes to their capability to successfully and rigorously implement the projects proposed. In some cases the impact of failing in the implementation of manufacturing strategies, because of poor project management, can have disastrous implications.

This handbook and the Strategic Manufacturing Implementation process

This handbook is intended as a guide to the management of the implementation of Strategic Manufacturing Initiatives (SMI). It sets out in a series of stages the main steps in this process. The intention is to provide a generic methodology that will help to ensure that the implementation of SMIs are rigorous and successful. However, this handbook does not replace procedures, experience, or provide a fool proof method. It is simply a well intended aid that could and should be enhanced to more closely fit with the manufacturing environment in which it is going to be used. This handbook can be used in two ways. Firstly, to act as a step by step methodology for Senior Management, Project Managers and Project Teams involved in the implementation of SMIs, by providing guidelines, tools and techniques to assist in the management of the project. Secondly, it provides an overall view of the activities involved in SMI implementation projects, for those who wish to quickly familiarise themselves with this process.

SOME BASIC CONCEPTS

What do we mean by Manufacturing Strategy?
A Manufacturing Strategy denotes a pattern of decisions which determine the capability of a manufacturing system and specify how it will operate in order to meet a set of manufacturing competitive criteria which are consistent with overall business objectives.

What kind of Strategic Decisions can we make in manufacturing?
The strategic decisions in manufacturing can be classified as follows:
New product/service development:
Should the operation be developing its own novel product or service ideas or following the lead of others?
How should the operation decide which products or services to develop and how to manage the development process?
Vertical integration:
Should the operation expand by acquiring its suppliers or its customers?
If the former, what suppliers should it acquire?
If the later, what customers should it acquire?
What balance of capabilities should it develop along its network of operations?
Facilities:
What number of geographically separate sites should the operation have?
Where should the operations facilities be located?
What activities and capacity should be allocated to each plant?
Technology:
What broad types of technology should the operation be using?
Should it be at the leading edge of technology or wait until the technology is established?
What technology should the operation be developing internally and what should it be buying in?
Workforce and organisation:
What role should the people who staff the operation play in its management?
How should responsibility for the activities of the operations function be allocated between different groups in the operation?
What skills should be developed in the staff of the operation?
Capacity adjustment:
How should the operation forecast and monitor the demand for its products and services?
How should the operation adjust its activity levels in response to demand fluctuations?
Supplier development:
How should the operation choose its suppliers?
How should it develop its relationship with its suppliers?
How should it monitor its suppliers' performance?

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SOME BASIC CONCEPTS

What kind of Strategic Decisions can we make in manufacturing? (continued)

Inventory:

How should the operation decide how much inventory to have and where it is to be located?
How should the operation control the size and composition of its inventories?

Planning and control systems:

What system should the operation use to plan its activities?
How should the operation decide the resources to be allocated to its various activities?

Improvement:

How should the operation's performance be measured?
How should the operation decide whether its performance is satisfactory?
How should the operation ensure that its performance is reflected in its improvement priorities?
Who should be involved in the improvement process?
How fast should the operation expect improvement in performance to be?
How should the improvement process be managed?

Failure prevention and recovery:

How should the operation maintain its resources so as to prevent failure?
How should the operation plan to cope with a failure if one occurs?

What capabilities define a Manufacturing system?

The capability of a Manufacturing System refers to its competence in Delivery Lead-time, Reliability, Features, Quality, Flexibility, Volume, and Price.

So, what is a Strategic Manufacturing Initiative and how is it formed?

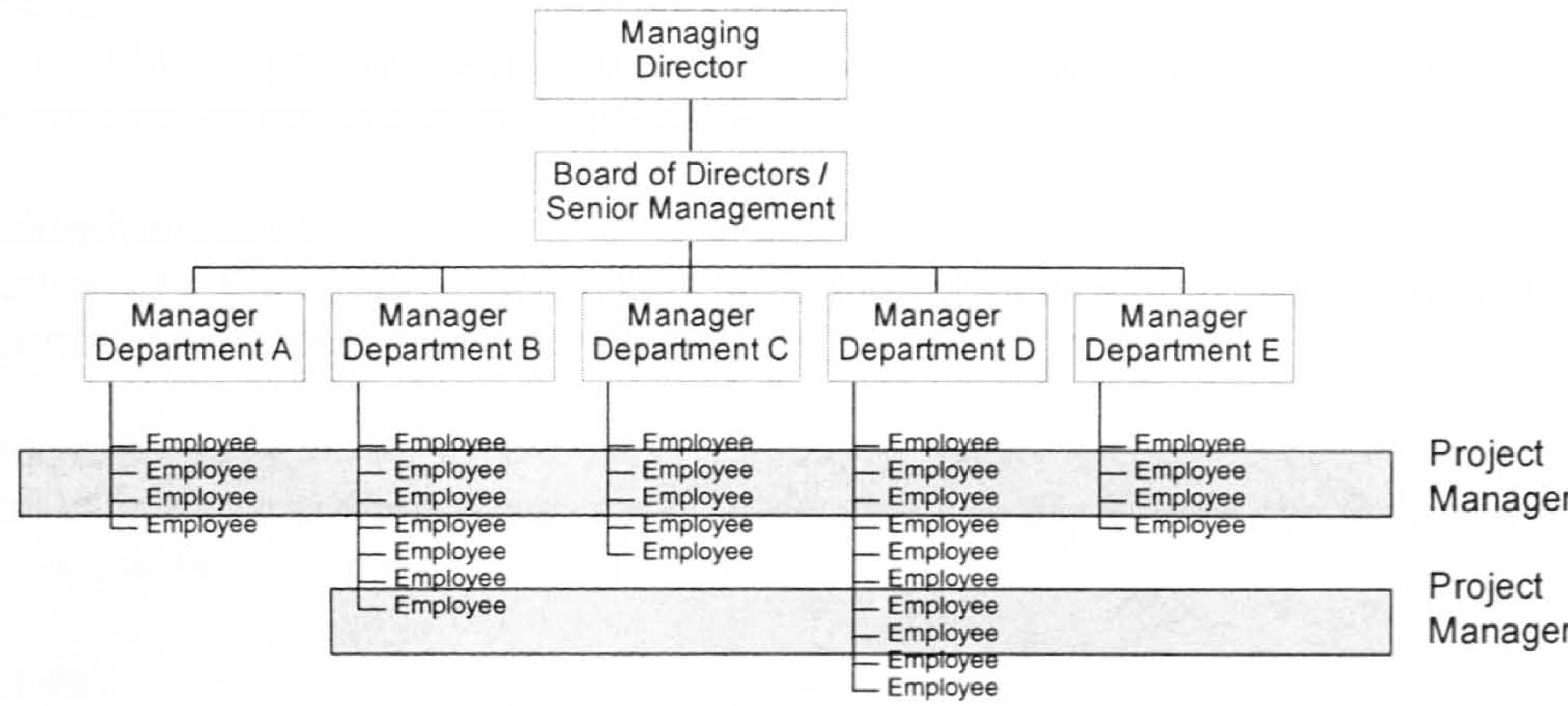
A Strategic Manufacturing Initiative (SMI) is a major manufacturing effort that will have a material and strategic impact on either the manufacturing external competitive edge, its internal capabilities or its financial performance – or all three.
A SMI can be formed as a result of a Manufacturing Strategy Formulation process such as the one proposed by the Department of Trade and Industry [DTI (1988), Competitive Manufacturing – A practical approach to the development of a manufacturing strategy, IFS Publications, London], or as an Unintended Opportunity identified during the implementation of other SMIs or recognized during the day-to-day operation of the organisation.

SOME BASIC CONCEPTS

What organisational structure do we need to implement Strategic Manufacturing Initiatives?

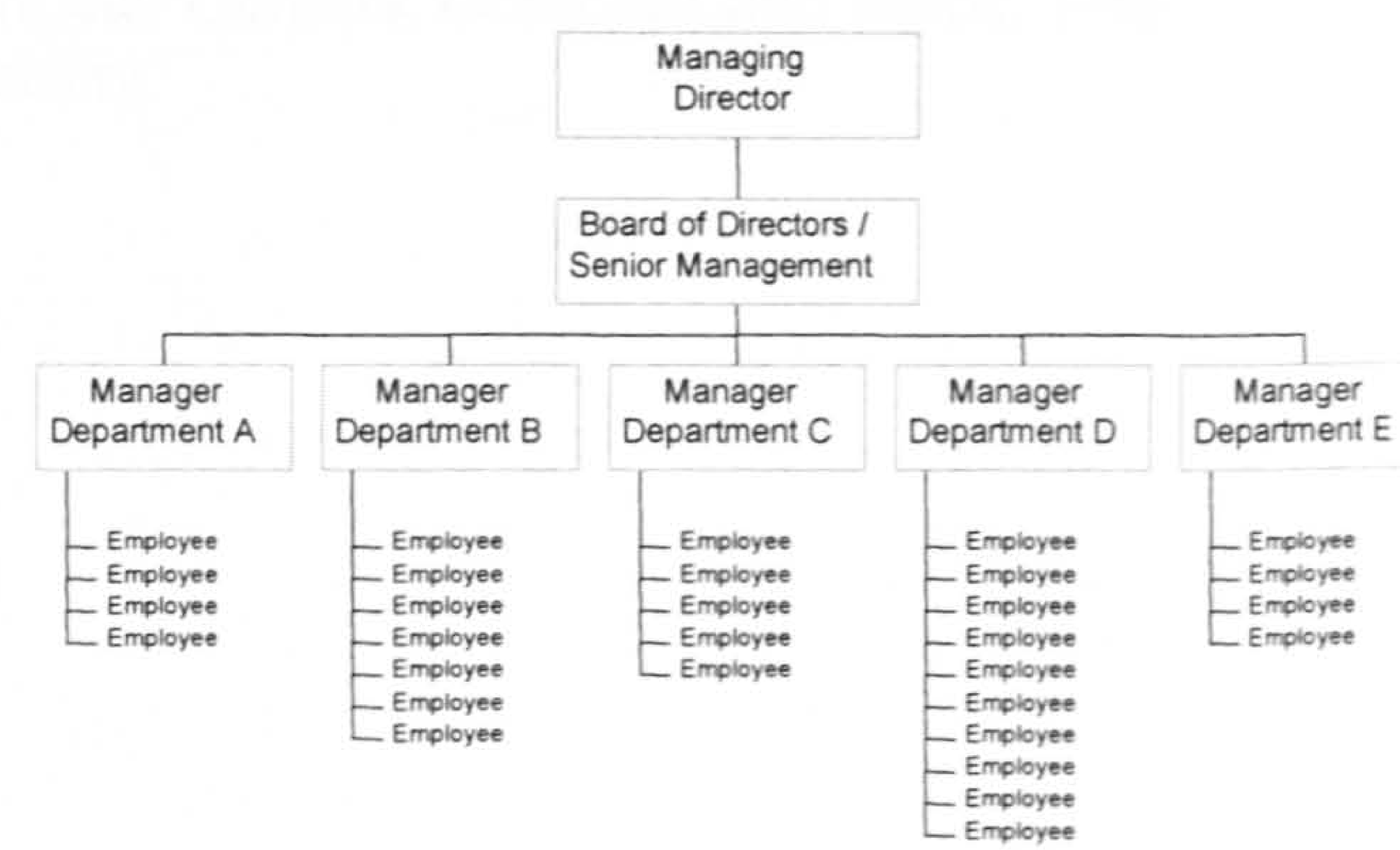
1. Formal Hierarchical Organisation:

A Formal Hierarchical Organisation combines the day-to-day control and achievement of manufacturing forecasts and plans with the management of parallel improvement processes in the same functional departments. Project Managers and cross-functional Project Team Members would usually be seconded for limited and frequently part-time periods of time to the implementation of Strategic Manufacturing Initiatives.



2. The Dual Organisation:

A Dual Organisation is a permanent organisational arrangement which exists alongside the Formal Hierarchical Organisation and is used to facilitate and manage the improvement process in the organisation as a whole. Project Manager is usually a role within the organisation and Project Teams are formed by a combination of full time members of the Dual Organisation and cross-functional members of the Formal Hierarchical Organisation.



HOW TO USE THIS HANDBOOK

Formulate a Manufacturing Strategy before using this handbook
A Manufacturing Strategy must be formulated and a set of of potential Strategic Manufacturing Initiatives and their correspondent business cases must be carried out prior to the start of the Implementation process described in this handbook.

Use this handbook when implementing Strategic Manufacturing Initiatives
A Strategic Manufacturing Initiative project can be the implementation of a Six Sigma system, Design For Manufacture programme, Vertical Integration Initiative, Line Transfer to another facility, Customer demand management Initiative, etc.

Use this handbook as a guide to the overall SMI implementation process
This handbook describes the principal steps in the implementation of SMIs, and provides an aid to understanding the overall structure of this implementation process. The complete process is described as five stages.

Use this handbook as a guide to individual stages in the process
Each stage in the SMI implementation process is described. Usually stages have been broken down into two or more steps. In creating this handbook, a balance has been sought between providing sufficient guidance for an activity, but without introducing so much detail that the user becomes bogged down and frustrated. Hopefully, the sacrifices in detail are far outweighed by usability.

Be aware that each stage follows a consistent structure
Each stage in the SMI implementation process is described in terms of Stage number, Title, Inputs, Outputs, Objective and Steps. This complete description for each stage is described in just one page, which again should aid usability.

Note that the process is sequential
A step-wise sequence is implied and it is important that all stages are completed sequentially.

OVERVIEW OF THE METHODOLOGY

Stage	Title	
1	Strategic / Financial Benefits and Duration	
Inputs		Outputs
- Set of SMIs - SMIs Strategic Benefits, Financial Benefits and estimated Duration		- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and Duration

Stage	Title	
1.1	Prioritise SMIs	
Inputs		Outputs
- Set of SMIs - SMIs Strategic Benefits, Financial Benefits		- Selected SMI to be implemented

Stage	Title	
1.2	Document Strategic Benefits	
Inputs		Outputs
- Selected SMI to be implemented - SMI Strategic Benefits		- Documented SMI Strategic Benefits

Stage	Title	
1.3	Document Financial Benefits and Duration	
Inputs		Outputs
- Selected SMI to be implemented - SMI Financial Benefits and estimated Duration		- Documented SMI Financial Benefits and Duration

Stage	Title	
2	Resources and Assessments of Benefits & Duration	
Inputs		Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration		- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets

Stage	Title	
2.1	Select Project Manager and formalise incentives	
Inputs		Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration		- Project Manager

Stage	Title	
2.2	Select Project Team members and formalise incentives	
Inputs		Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration		- Project Team

Stage	Title	
2.3	Diagnose SMI and identify Special Resources	
Inputs		Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration		- SMI Diagnosis and Special Resources

Stage	Title	
2.4	Scope SMI (agreement of benefits and duration)	
Inputs		Outputs
- Selected SMI to be implemented - SMI Diagnosis		- SMI Scope and agreement of targets

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OVERVIEW OF THE METHODOLOGY

Stage	Title
3	Activities and Control

Inputs	Outputs
- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control

Stage	Title
3.1	Formalise Milestones

Inputs	Outputs
- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Milestones

Stage	Title
3.2	Define Activities and allocate responsibilities

Inputs	Outputs
- SMI Milestones - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Activities

Stage	Title
3.3	Activity Planning and Time Control

Inputs	Outputs
- SMI Scope and agreement of targets - SMI Milestones - SMI Activities	- SMI Time Control

Stage	Title
3.4	Cost Control

Inputs	Outputs
- Special Resources - SMI Scope and agreement of targets - SMI Time Control	- SMI Cost Control

Stage	Title
4	Communication and Training Plans

Inputs	Outputs
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control	- SMI Communication Plan - SMI Training Plan - SMI Technical Documentation

Stage	Title
4.1	Communication Plan

Inputs	Outputs
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control	- SMI Communication Plan

Stage	Title
4.2	Training Plan

Inputs	Outputs
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control	- SMI Training Plan

Stage	Title
4.3	Technical Documentation

Inputs	Outputs
- SMI Milestones and SMI Activities	- SMI Technical Documentation

Stage	Title
5	Reviews

Inputs	Outputs
- Outputs from all the Stages	- Milestones Review - Implementation Process Review

Stage	Title
5.1	Deliverables Review

Inputs	Outputs
- Outputs from all Stages	- SMI Milestones Reviews - SMI Benefits Review

Stage	Title
5.2	Implementation Process Review

Inputs	Outputs
- Outputs from all Stages	- SMI Implementation Process Review

Understanding Roles

ROLE	DESCRIPTION
Senior Management	Level of management that have the capability to launch Strategic Manufacturing Initiatives, and influence and decide strategic decisions providing a high degree of support to strategic projects
Project Manager	People that drive, own and facilitate the methodology of Strategic Manufacturing Initiative implementation
Project Team Members	People who perform the implementation activities of the project, probably internal to the organisation
Project Team	The Project Manager and Project Team Members
Manufacturing employees	People internal to the organisation who are affected by the Strategic Manufacturing Initiatiave but are not directly involved in its implementation

Understanding Responsibilities

Stages			Responsibilities
Stage 1 Strategic / Financial Benefits and Duration	**1.1**	Prioritise SMIs	Senior Management
	1.2	Document Strategic Benefits	Senior Management
	1.3	Document Financial Benefits and Duration	Senior Management
Stage 2 Resources and Assessments of Benefits and Duration	**2.1**	Select Project Manager and formalise incentives	Senior Management
	2.2	Select Project Team Members and formalise incentives	Project Manager
	2.3	Diagnose SMI and identify Special Resources	Project Team
	2.4	Scope SMI (agreement of benefits and duration)	Project Team / Senior Management
Stage 3 Activities and Control	**3.1**	Formalise Milestones	Project Team
	3.2	Define Activities and allocate responsibilities	Project Team
	3.3	Activity Planning and Time Control	Project Team
	3.4	Cost control	Project Team
Stage 4 Communication and Training Plans	**4.1**	Communication Plan	Project Team
	4.2	Training Plan	Project Team
	4.3	Technical Documentation	Project Team
Stage 5 Reviews	**5.1**	Deliverables Review	Project Manager / Senior Management
	5.2	Implementation Process Review	All

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Stage	Title	
1	**Strategic / Financial Benefits and Duration**	
Inputs		**Outputs**
- Set of SMIs - SMIs Strategic Benefits, Financial Benefits and estimated Duration		- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and Duration

Objective

Before embarking into the implementation of a Strategic Manufacturing Initiative (SMI), the organisation must have formulated its manufacturing strategy. The key outcome of this formulation process will be a set of SMIs and the related business cases, strategic link analyses and estimated durations. There must be noted at this stage that SMIs may also be identified by different members of the organisation during the implementation process of other Strategic Manufacturing Initiatives (Stage 4.1, Step 5). On completion of this stage, a specific SMI will be selected for implementation and its strategic and financial benefits and estimated duration will be documented for inclusion in the formalised Project documentation in order to achieve common strategic understanding and better strategic decision making at all levels including Senior Management, Project Manager, Project Team Members and other manufacturing employees.

To realise this stage, the following sections will be carried out:

Stage 1.1 Prioritise SMIs
Stage 1.2 Document Strategic Benefits
Stage 1.3 Document Financial Benefits and Duration

Stage	Title
1.1	**Prioritise SMIs**
Inputs	**Outputs**
- Set of SMIs - SMIs Strategic Benefits, Financial Benefits	- Selected SMI to be implemented

Objective

The objective of Stage 1.1 is to select the SMI to be implemented. The intention is to avoid that the manufacturing organisation takes on too many Strategic Manufacturing Initiatives resulting in overstretched financial resources and diluting attention to the really important projects. In performing this stage, we will avoid that marginal projects are undertaken whereas the comparatively more attractive are left behind.

Steps

The following steps will be carried out by ***Senior Management*** and documented following the format presented in Worksheet 1.1a,b and c:

1. Draw the current Manufacturing Performance and Market Requirements profiles based on the seven strategic performance areas shown in Profiles 1 and 2. Profile 3 is the composite of Profiles 1 and 2. This information should be provided by the strategy formulation process.

2. Evaluate the degree of Strategic Impact (High, Medium or Low) based on the amount of strategic gap reduction between manufacturing performance and market requirements that would be achieved after the successful implementation of the SMI.

3. Evaluate the viability (*Favourable*, *Individually favourable* or *Unfavourable*) of the SMI implementation. A financially *Favourable* SMI means that the financial support required to implement the initiative is minimum or none. A *Individually favourable* SMI means that the level of financial support required to implement the initiative is affordable under current conditions but it will constrain financial resources for the implementation of other initiatives or projects at the same time. A financially *Unfavourable* SMI means that currently it is not possible to financially support this initiative even if it is the only project to be implemented in the organisation.

4. Prioritise SMIs by using the graph showed in Worksheet 1.1a. The order of priority is shown in this graph in sequential order.

5. When two or more SMIs share the same level of Strategic Impact and Financial Conditions, priority will be given to the SMI that is estimated to require the minimum amount of other resources such as human resources or machines.

6. Provide the Title and Description of the SMI selected using Worksheet 1.1b.

Worksheet 1.1a – Strategic Analysis

PROFILE 1: MANUFACTURING PERFORMANCE

Delivery Lead-time	Short	Long
Reliability	Variable	Good
Features	Few	Many
Quality	Acceptable	High
Flexibility	Stantard	Customised
Volume	Low variations	High variations
Cost	Low	High

PROFILE 2: MARKET REQUIREMENTS

Delivery Lead-time	Ex-stock	Not significant
Reliability	Into stock point	Critical: Project delay
Features	Fit for purpose	Many features
Quality	Acceptable at price	Total reliability essential
Flexibility	Stantard	Customer specified
Volume	Limited variation required	Variable market
Price	Dominant	Non-price dominant

COMPOSITE OF PROFILES 1 and 2

Delivery Lead-time

Reliability

Features

Quality

Flexibility

Volume

Price/Cost

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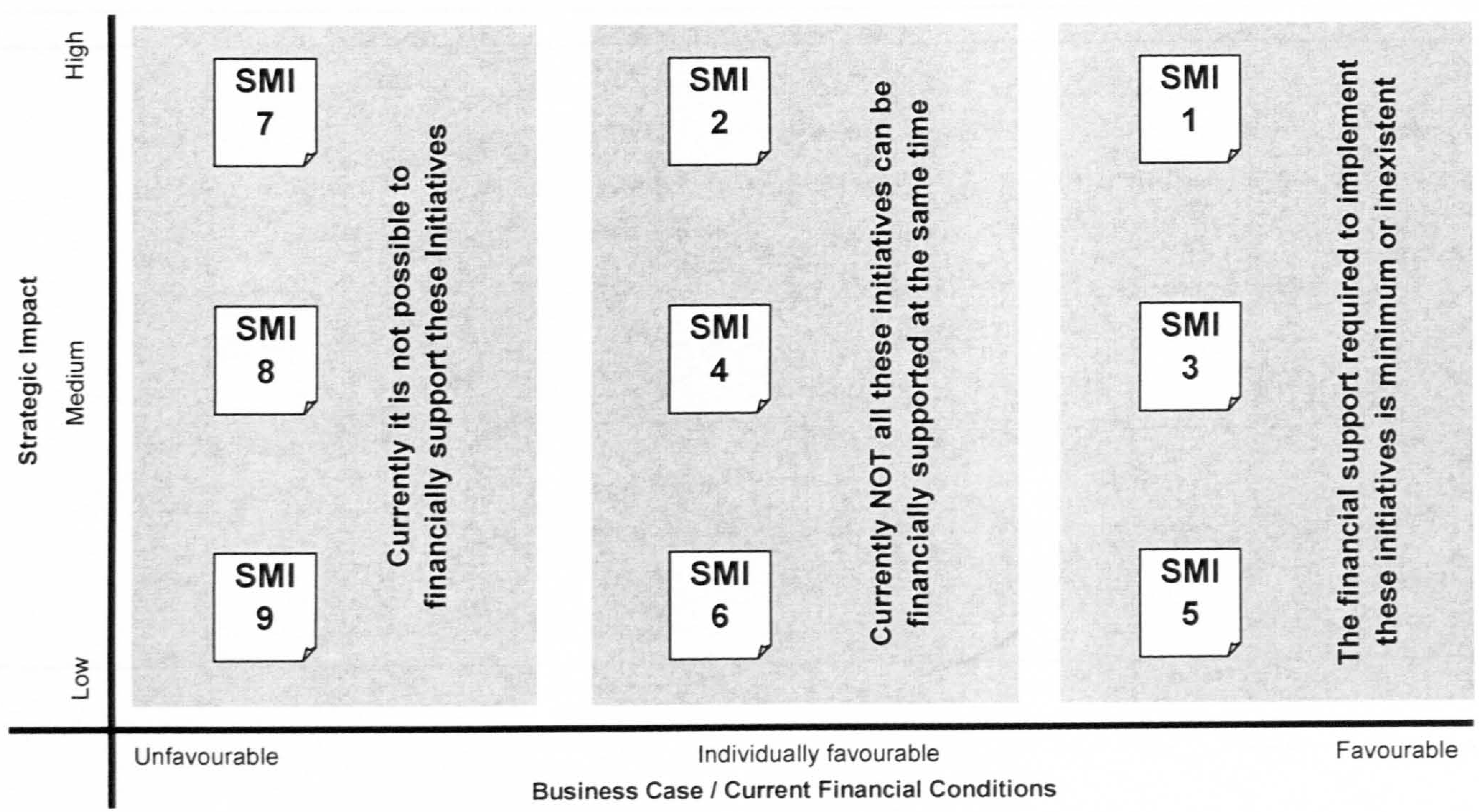
Worksheet 1.1b – Prioritise SMIs

Criteria \ Options	SMI 1	SMI 2	SMI 3	SMI 4
Strategic Impact				
Business case / Current Financial Conditions				



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Worksheet 1.1c – Selected SMI

STRATEGIC MANUFACTURING INITIATIVE

IMPLEMENTATION

Title

Description

Stage	Title
1.2	**Document Strategic Benefits**

Inputs	**Outputs**
- Selected SMI to be implemented - SMI Strategic Benefits	- Documented SMI Strategic Benefits

Objective

The objective of Stage 1.2 is to document the Strategic Benefits of the selected Strategic Manufacturing Initiative to be implemented. The intention is to ensure that everyone involved or affected by the SMI is aware of its strategic benefits. Therefore everyone would be able to make better decisions during the different stages of the SMI implementation project aiming to achieve the strategic benefits set out.

Steps

For the SMI selected in Stage 1.1, the following steps will be carried out by ***Senior Management*** in order to document the Strategic Benefits to be achieved after successful implementation of the SMI, following the format showed in Worksheet 1.2:

1. Draw the current Manufacturing Performance and Market Requirements profiles based on the seven strategic performance areas shown in Profiles 1 and 2. This information should be provided in the formulation of the manufacturing strategy.

2. Draw the composite of Profiles 1 and 2 in Profile 3.

3. Explain in detail the changes in Manufacturing Performance and Market requirements profiles expected to be achieved after the implementation of the Strategic Manufacturing Initiative selected. These changes would reflect a reduction of the gap separating Profiles 1 and 2 in one or more of the seven strategic areas presented.

Worksheet 1.2 - Strategic Benefits

PROFILE 1: MANUFACTURING PERFORMANCE

Delivery Lead-time	Short	Long
Reliability	Variable	Good
Features	Few	Many
Quality	Acceptable	High
Flexibility	Stantard	Customised
Volume	Low variations	High variations
Cost	Low	High

PROFILE 2: MARKET REQUIREMENTS

Delivery Lead-time	Ex-stock	Not significant
Reliability	Into stock point	Critical: Project delay
Features	Fit for purpose	Many features
Quality	Acceptable at price	Total reliability essential
Flexibility	Stantard	Customer specified
Volume	Limited variation required	Variable market
Price	Dominant	Non-price dominant

COMPOSITE OF PROFILES 1 and 2

Delivery Lead-time

Reliability

Features

Quality

Flexibility

Volume

Price/Cost

Strategic benefits explained

Stage	Title	
1.3	**Document Financial Benefits and Duration**	
Inputs		**Outputs**
- Selected SMI to be implemented - SMI Financial Benefits and estimated Duration		- Documented SMI Financial Benefits and Duration

Objective

The objective of Stage 1.3 is to document the Financial Benefits and the estimated Duration of the selected Strategic Manufacturing Initiative to be implemented. The intention is to ensure that everyone involved or affected by the SMI is aware of its financial benefits and projected timescale. Therefore everyone would be able to make better decisions during the different stages of the SMI implementation project aiming to achieve the financial benefits and duration set out.

Steps

For the SMI selected in Stage 1.1, the following steps will be carried out by ***Senior Management*** in order to document the Financial Benefits and estimated Duration to be achieved after successful implementation of the SMI following the format showed in Worksheet 1.3:

1. Show the Financial Benefits or Business Case related to the SMI selected in the preferred way by the organisation (e.g. Return on Investment, Payback period, Internal Rate of Return, Net Present Value, etc). This information should be provided in the formulation of the manufacturing strategy.

2. Describe the Duration or Timescale of the SMI implementation project in which the Business Case is based on. This information should be provided in the formulation of the manufacturing strategy.

Worksheet 1.3 - Financial Benefits (Business Case)

Estimated Duration (Timescale)

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Stage	Title
2	**Resources and Assessments of Benefits & Duration**

Inputs	Outputs
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration	- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets

Objective

Allocation and management of resources is a fundamental requirement for effective SMI implementation project planning and management. One of the most critical factors is the selection of the Project Manager and the Project Team members. The objectives of this stage are to select the most appropriate human resources for the implementation project and to formalise their incentives to succeed, diagnose the SMI, identify special resources required. Finally the Project Team accepts or amends the initial targets set out by Senior Management..

To realise this stage, the following sections will be carried out:

Stage 2.1 Select Project Manager and formalise incentives

Stage 2.2 Select Project Team Members and formalise incentives

Stage 2.3 Diagnose SMI and identify Special Resources

Stage 2.4 Scope SMI (agreement of benefits and duration)

Stage	Title	
2.1	**Select Project Manager and formalise incentives**	
Inputs		**Outputs**
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration		- Project Manager

Objective

The objective of Stage 2.1 is that Senior Management recruits and provides the right incentives to the most appropriate Project Manager who possesses the necessary personal qualities to positively influence the ultimate success of the SMI implementation project. The success of the SMI implementation project is very much dependant on the Project Manager in charge of it. In order to increase the chances for success, the same Project Manager must stay during the whole duration of the strategic implementation and the selected Project Manager should be trained in the use of this workbook.

Steps

The following steps will be carried out by ***Senior Management*** in order to select the Project Manager following the format showed in Worksheet 2.1a:

1. List all the candidates in the top row of the matrix.

2. Assess each candidate's personal qualities against the nine factors listed in the first column, scoring 0 (horizontal line) if the candidate does not possess this quality, 1 (square) if the candidate does below average, 2 (circle) if the candidate does average, or 3 (triangle) if the candidate does well above average against this factor.

3. For each candidate multiply the score against each factor by the weight factor in the "Weight" column and add them in order to obtain the "Result" score. The Weight factor has been obtained from a extensive industrial survey and reflects the criticality of a factor. The preferred candidate will be the one with the highest score.

4. Use Worksheet 2.1b to formalise the proposal to the chosen candidate and detail the incentives offered. This Secondment sheet also shows the estimated duration of the project, the benefits/objectives to be achieved (these may change after the diagnosis and scope of the SMI by the Project Team once agreed with Senior Management).

Worksheet 2.1a – Select Project Manager

	Candidate A	Candidate B	Candidate C	Candidate D	Candidate E	Weight
1. Communication: Project manager is able to listen, understand, and communicate accurately and constantly	3					8
2. Committed to project scope.	2					7
3. Enthusiasm, positive attitude, creative thinking.	2					7
4. Strong goal orientation.	1					6
5. Ability to see the project as a whole.	2					6
6. Organizing skills.	0					6
7. Good knowledge and understanding of business and manufacturing strategic goals.	2					6
8. Planning skills.	0					6
9. Coping with situations: Project manager is flexible, patient and persistent.	3					6
10. Project manager is able to release the energies of this subordinates, project team members, ...	3					5
11. Delegating authority: Project manager is able to give the people the opportunity as group members to participate in making decisions.	2					5
TOTAL:	125					

Worksheet 2.1b – PM Secondment Sheet

SMI Implementation Project	

SMI Strategic Benefits	

SMI Financial Benefits	

PROJECT MANAGER	

Estimated Start Date	Estimated Finish Date	%Time seconded to SMI	Functional Responsibility

Responsibilities after secondment

Incentives upon achievement of Benefits

Project Manager (Signature)

Functional Manager (Signature) **Senior Management** (Signature)

Stage	Title
2.2	**Select Project Team members and formalise incentives**
Inputs	**Outputs**
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration	- Project Team

Objective

The objective of Stage 2.2 is that the Project Manager recruits and provides the right incentives to Project Team members and once agreed with Senior Management, changes in responsibilities from previous functional responsibilities are clearly communicated to them, and fully supported by their functional managers. If needed, Project Team members should be trained to carry out specific tasks and they should also be trained in the use of this workbook.

Steps

The following steps will be carried out by the ***Project Manager*** in order to select the Project Team members. Then the Project Manager will clearly communicate and agree their new responsibilities following the format showed in Worksheet 2.2a:

1. The Project Manager selects Project Team Members based on the following guidelines:

a. As far as possible, multifunctional members are selected from different departments
b. Project Team members are selected based on their skills or capability regarding to the SMI to be implemented
c. Project Team members show enthusiasm, positive attitude and creative thinking
d. Project Team members show commitment to the project scope once they are approached

2. Project Manager use Worksheet 2.2a to formalise the proposal to the chosen Project Team member and detail the incentives offered. This Secondment sheet also shows the estimated duration of the project, the benefits/objectives to be achieved (these may change after the diagnosis and scope of the SMI by the Project Team once agreed with Senior Management), and the responsibilities after completion of the project. The sheet must be signed by the Project Team member, Functional Manager, Project Manager, and Senior Management.

3. Project Manager use Worksheet 2.2b to formalise and summarise the structure of the Project Team.

Worksheet 2.2a – PTM Secondment Sheet

SMI Implementation Project	

SMI Strategic Benefits	

SMI Financial Benefits	

PROJECT TEAM MEMBER	

Estimated Start Date	Estimated Finish Date	%Time seconded to SMI	Functional Responsibility

Responsibilities after secondment

Incentives upon achievement of Benefits

Project Team Member (Signature) **Project Manager** (Signature)

Functional Manager (Signature) **Senior Management** (Signature)

Worksheet 2.2b - SMI Project Team

PROJECT MANAGER	

PROJECT TEAM MEMBERS	Estimated Start Date	Estimated Finish Date	%Time seconded to SMI	Functional Responsibility	Functional Manager
1					(Signature)
2					(Signature)
3					(Signature)
4					(Signature)
5					(Signature)
6					(Signature)
7					(Signature)
8					(Signature)

Stage	Title	
2.3	**Diagnose SMI and identify Special Resources**	
Inputs		**Outputs**
- Selected SMI to be implemented - Documented SMI Strategic Benefits, Financial benefits and estimated Duration		- SMI Diagnosis and Special Resources

Objective

The objective of Stage 2.3 is that the Project Team performs an initial analysis of the project that they are facing. The Project Team will diagnose the key issues of the SMI including why the current practice is the way it is or why current problems exist (using Fishbone analysis), and looking at the ways in which factors and conditions are required to change to fulfil the SMI as a new manufacturing practice (using Wishbone analysis). Special machine or organisational resources required must be identified by the Project Manager and Project Team Members at this Diagnosis stage of the implementation project and they must be discussed, agreed and provided by Senior Management. Other Special Resources needs generated during the implementation process will have to be won in competition with other projects and day-to-day operation.

Steps

The following steps will be carried out by the ***Project Team*** and documented following the format presented in Worksheet 2.3:

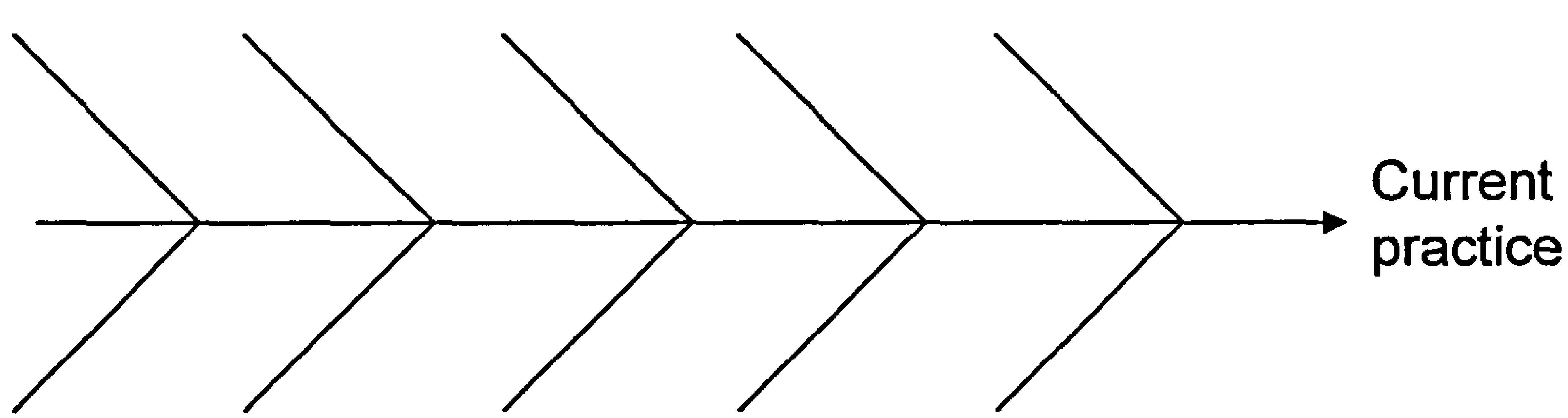
1. Using the Fishbone technique shown in Worksheet 2.3 and based on Worksheets 1.1b (Title and Description of the SMI), 1.2 (SMI Strategic Benefits) and 1.3 (SMI Financial Benefits and Duration) list on the top side of the fishbone the reasons why the current practice that is going to be changed by the SMI is the way it is, and on the bottom side of the fishbone list the factors and conditions that will be affected by the change.

2. Using the Wishbone technique shown in Worksheet 2.3 and based on the Fishbone analysis performed in the previous step list the ways in which factors or conditions would had changed if the SMI was implemented and operational.

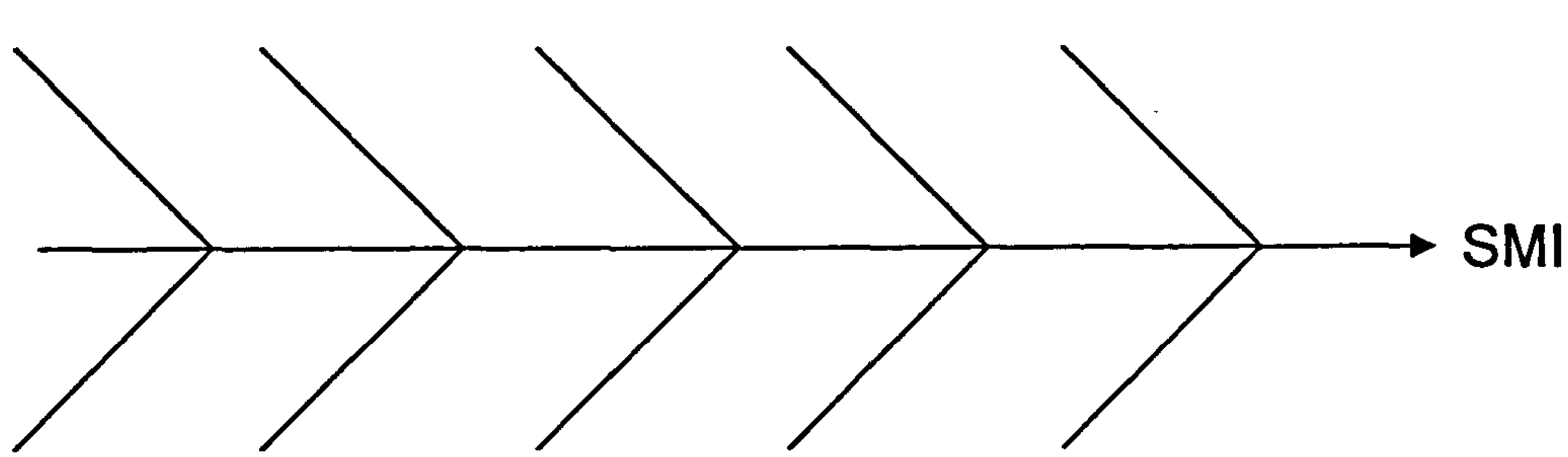
3. Based on the analysis performed in the previous two steps, list the Special Resources that can be identified to implement the SMI and document them in Worksheet 2.3.

Worksheet 2.3 - SMI Diagnosis

Fishbone analysis - Why the practice targeted is the way it is



Wishbone analysis – Factors/conditions to fulfil SMI (new practice)



Special resources identified

1. ________
2. ________
3. ________
4. ________

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Stage	Title	
2.4	**Scope SMI (agreement of benefits and duration)**	
Inputs		**Outputs**
- Selected SMI to be implemented - SMI Diagnosis		- SMI Scope and agreement of targets

Objective

The objective of Stage 2.4 is that the Project Team and Senior Management agree the project objectives, duration and initial special resources identified. The outcomes of this stage provide a clear and shared understanding of the project evaluation measures.

Steps

The following steps will be carried out and documented following the format presented in Worksheet 2.4:

1. The ***Project Team*** assesses the Strategic Benefits documented in Worksheet 1.2 and accepts or rejects them. If they are rejected the Project Team will define the alternative Strategic Benefits that will be presented to Senior Management for evaluation.

2. The ***Project Team*** assesses the Financial Benefits documented in Worksheet 1.3 and accepts or rejects them. If they are rejected the Project Team will define the alternative Financial Benefits that will be presented to Senior Management for evaluation.

3. The ***Project Team*** assesses the Duration documented in Worksheet 1.3 and accepts or rejects it. If it is rejected the Project Team will define the alternative Duration that they can identify and that will be presented to Senior Management for evaluation.

4. ***Senior Management*** assesses the Strategic Benefits, Financial Benefits, Duration of the project and Special Resources documented by the Project Team in Worksheet 2.3 and accepts or rejects them. If they are rejected Senior Management will discuss the issues with the Project Team until an agreement is reached. Any agreements should be documented in Worksheet 2.4. At this point Senior Management can end the project if no agreement is reached.

Worksheet 2.4 - SMI Scope

Strategic Benefits

Are the initial Strategic Benefits accepted by the Project Team? Yes No

If Not, list here the New Strategic Benefits proposed

Financial Benefits

Are the initial Financial Benefits accepted by the Project Team? Yes No

If Not, list here the New Financial Benefits proposed

Duration of the SMI Implementation Project

Is the initial Duration accepted by the Project Team? Yes No

If Not, list here the New Duration proposed

Comments about agreements

Agreement of Benefits, Duration and Special Resources

Agreed Strategic Benefits:	Agreed Financial Benefits:	Agreed Duration:	Agreed Special Resources:
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5

(Signed by Senior Management)

(Signed by Project Manager and Project Team Members)

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Stage	Title
3	Activities and Control

Inputs	Outputs
- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control

Objective

The objectives of Stage 3 is to plan and control the evolution of the project in terms of time, cost and quality planning of the SMI implementation. This will involve defining project milestones, determining and planning the individual activities, estimating and controlling project costs, and planning and assuring the quality process. The planning and control processes are needed to achieve the strategic and financial objectives of the project as well as the agreed duration of the implementation.

To realise this stage, the following sections will be carried out:

Stage 3.1 Formalise Milestones
Stage 3.2 Define Activities and allocate responsibilities
Stage 3.3 Activity planning and time control
Stage 3.4 Cost control

Stage	Title
3.1	**Formalise Milestones**

Inputs	Outputs
- Project Manager and Project Team - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets	- SMI Milestones

Objective

The objective of Stage 3.1 is that the Project Team define and document the SMI implementation Milestones. A project milestone is a key project deliverable or key indicator of progress and the time by which it is going to be achieved. Project milestones are used by the Project Manager as stages in the development of the project and by the Project Team to further detail specific project activities. They are also used by the Senior Management in project reviews.

Steps

The following steps will be carried out by the ***Project Team*** and documented following the format presented in Worksheet 3.1:

1. Referring to Worksheet 2.3 (SMI Diagnosis) and Worksheet 2.4 (SMI Scope) the Project Manager and the Project Team Members define the Project Milestones and the time by which the team aims to complete them. These will be documented in Worksheet 3.1.

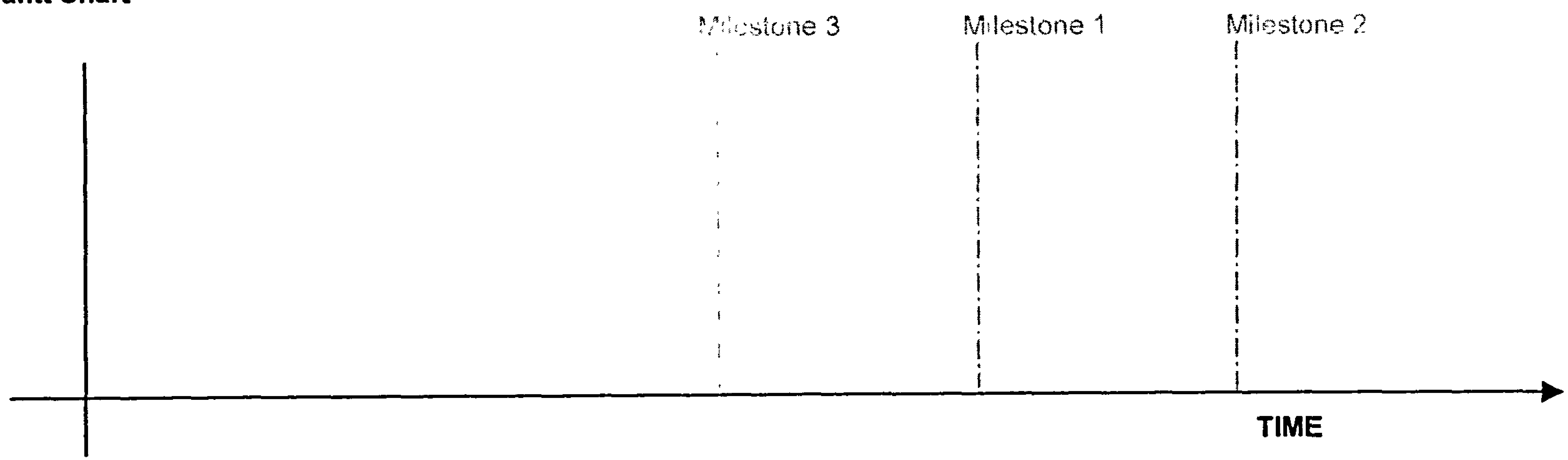
2. The Milestones identified are graphically displayed using a Gantt Chart as shown in Worksheet 3.1 which shows Milestones over particular times.

Worksheet 3.1 - SMI Milestones

Project milestones | **By when?**

1 ____________________ | ________
2 ____________________ | ________
3 ____________________ | ________

Gantt Chart



Stage	Title	
3.2	**Define Activities and allocate responsibilities**	
Inputs		**Outputs**
- SMI Milestones - SMI Diagnosis and Special Resources - SMI Scope and agreement of targets		- SMI Activities

Objective

The objective of Stage 3.2 is that the Project Team define and document the SMI implementation Activities using the How-How technique. The project activities are those tasks that must be performed to produce the Milestones identified. Implicit in this stage is the need to define the activities such that the project Benefits will be met.

Steps

The following steps will be carried out and documented following the format presented in Worksheet 3.2:

1. Referring to Worksheet 3.1 (SMI Milestones) the ***Project Team*** define the Activities that must be completed to achieve the Project Milestones by performing a How-How Analysis. By working from left to right, the Project Team should repeatedly ask themselves how a particular Milestone and subsequent activities will be achieved until a set of well detailed activities is identified. These activities will also include training needs and other support activities for behavioural or mind-set change.

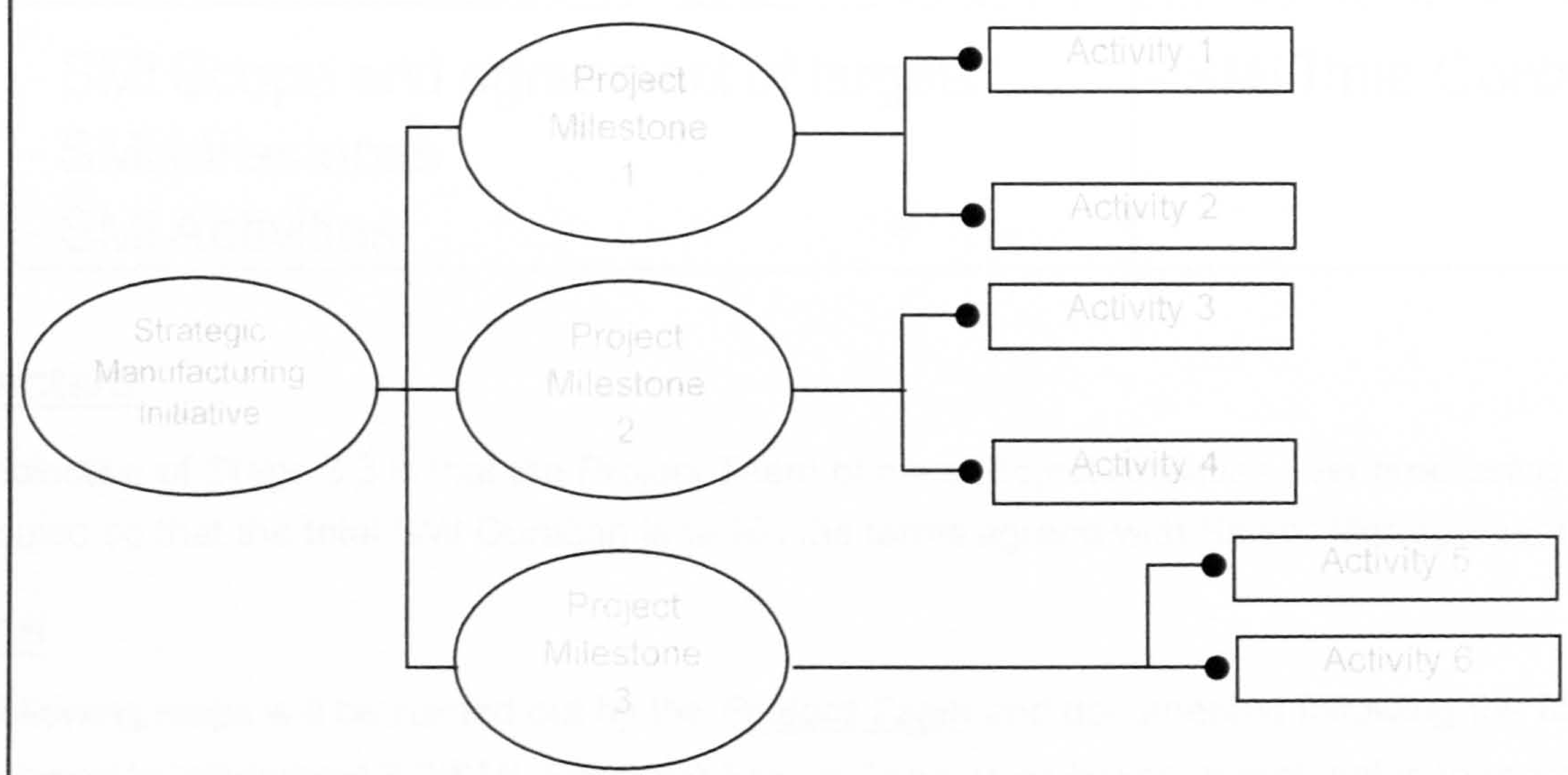
2. Besides the activities resulting from the How-How analysis set out to achieve the Milestones and benefits defined for the project, the Project Team must define a set of Quality Planning Activities that will ensure that the project will satisfy the relevant quality system, and Quality Control Activities to monitor specific project results to determine if they comply with relevant quality standards.

3. The ***Project Team*** lists all the activities that will be performed on the project based on the How-How analysis and the Quality Control activities. The activity list should include descriptions of each activity to ensure that the project team members understand how the work is to be done.

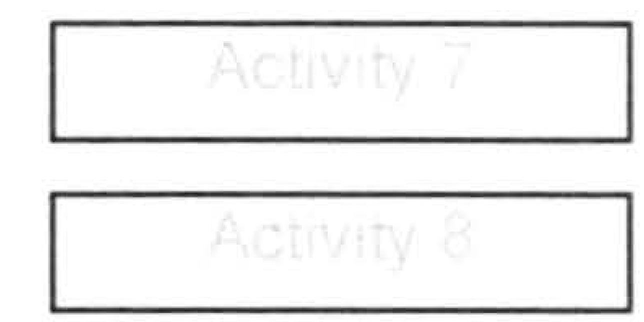
4. Allocate responsibilities. Accountability is critical for the successful implementation of activities. The ***Project Manager*** must allocate every activity to a Project Team Member. The distribution of responsibilities must be made very clear to the whole team and documented using Worksheet 3.2. Project Team Members will act as champions for their allocated activities.

Worksheet 3.2 - SMI Activities

How-How analysis



Quality Control Activities



Project activities

1 ____________________ 5 ____________________
2 ____________________ 6 ____________________
3 ____________________ 7 ____________________
4 ____________________ 8 ____________________

Responsibilities

	Project Team Member
Activity 1	
Activity 2	
Activity 3	
Activity 4	

	Project Team Member
Activity 5	
Activity 6	
Activity 7	
Activity 8	

Stage	Title
3.3	**Activity Planning and Time Control**

Inputs	Outputs
- SMI Scope and agreement of targets - SMI Milestones - SMI Activities	- SMI Time Control

Objective

The objective of Stage 3.3 is that the Project Team phases Project Activities over time using a Gantt Chart. The project activities should be scheduled so that the total SMI Duration is within the terms agreed with Senior Management in Worksheet 2.4 (SMI Scope).

Steps

The following steps will be carried out by the ***Project Team*** and documented following the format presented in Worksheet 3.3:

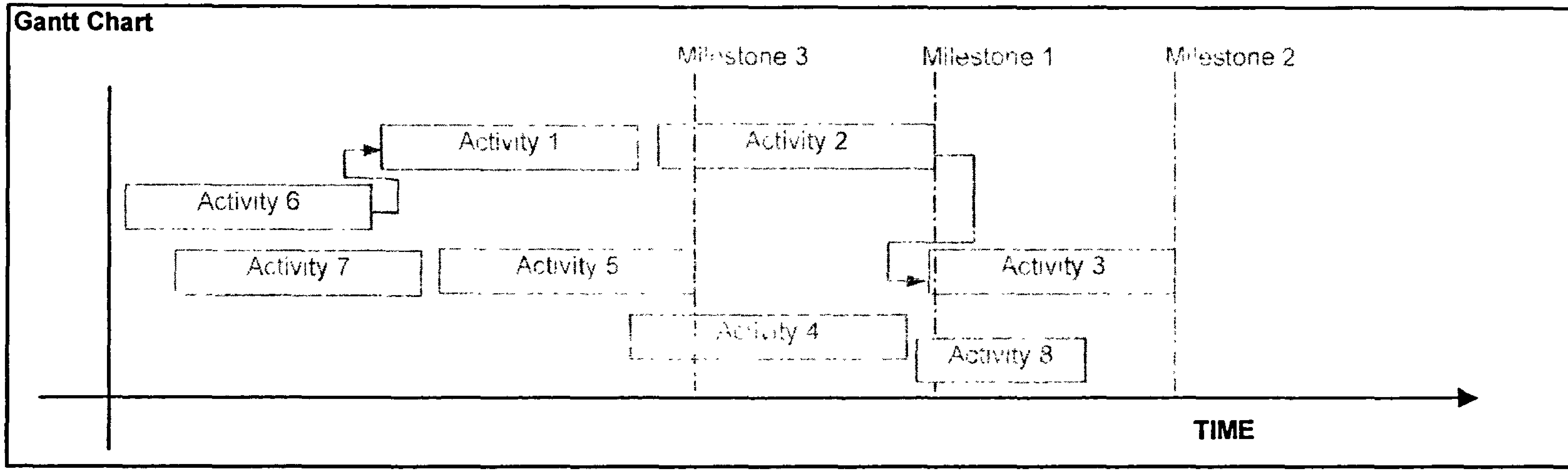
1. Referring to Worksheet 3.2(SMI Activities) Project Team uses boxes or rectangles to represent activities and their estimated duration and connects them with arrows that show the precedence of an activity over other if any. Activities must be planned in parallel whenever possible in order to keep the duration of the project as short as possible. This is graphically documented in Worksheet 3.3.

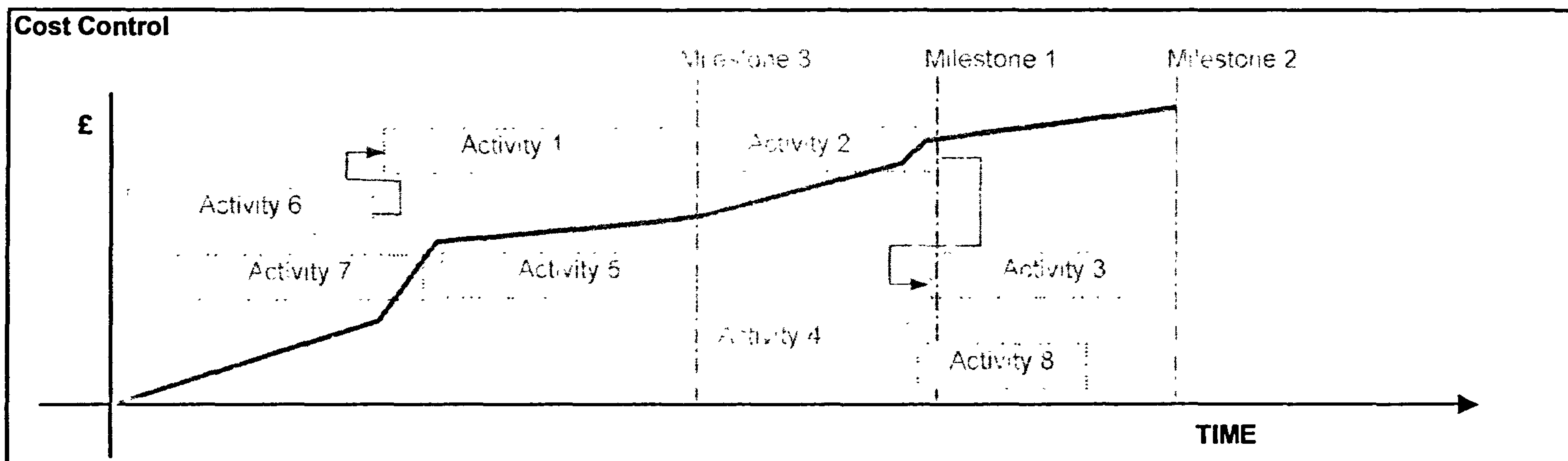
2. Project Team adds Project Milestones to the graph in order to create the completed SMI Time Control – Gantt chart.

3. During the life of the implementation project, a superposed graph representing the actual duration of each activity in time will be drawn. The Project Manager and Project Team members will monitor the duration of the implementation project and act accordingly.

4. If the actual timescale exceeds significantly the estimated duration and consequently a strategic, financial or duration target is threatened, then the team must communicate this issue to Senior Management using Worksheet 4.1b – Critical Decision.

Worksheet 3.3 - SMI Time and Cost Control





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Stage	Title	
3.4	**Cost Control**	
Inputs		**Outputs**
- Special Resources - SMI Scope and agreement of targets - SMI Time Control		- SMI Cost Control

Objective

The objective of Stage 3.4 is that the Project Team controls the costs of the project over time in order to ensure that the SMI implementation is completed within the agreed financial analysis.

Steps

The following steps will be carried out by the ***Project Team*** and documented following the format presented in Worksheet 3.3:

1. The Project Team estimates the cost over time to be incurred during the implementation of each activity.

2. Referring to the Gantt Chart on the top of Worksheet 3.3 showing the SMI Time Control Gantt Chart, estimated activities' costs are accumulated and displayed as shown in the Cost Control Graph in Worksheet 3.3. This line represents the estimated level of costs at every stage of the implementation and it will be monitored by the Project Manager and Project Team members.

3. During the life of the implementation project, a line representing the actual costs incurred will be drawn. The Project Manager and Project Team members will monitor the progress of costs and act accordingly.

4. If actual costs exceed significantly the estimated costs and consequently a strategic, financial or duration target is threatened, then the team must communicate this issue to Senior Management using Worksheet 4.1b – Critical Decision.

Stage	Title
4	**Communication and Training Plans**

Inputs	Outputs
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control	- SMI Communication Plan - SMI Training Plan - SMI Technical Documentation

Objective

The objectives of Stage 4 are to develop a Project Communication strategy, to plan the manufacturing-wide Training needs for the successful implementation of the SMI, and to compile all the technical documentation relevant to the implementation effort. Everyone involved in the project including the Project Manager, Project Team Members and Senior Management must understand how the communications of the strategic project in the manufacturing organisation are going to be carried out and the accountability for these communications. The role of Senior Management in communication is critical. Senior Management must provide full, active and clearly visible support to the project during it whole life.

To realise this stage, the following sections will be carried out:

Stage 4.1 Communication Plan
Stage 4.2 Training Plan
Stage 4.3 Technical Documentation

Stage	Title	
4.1	**Communication Plan**	
Inputs		**Outputs**
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control		- SMI Communication Plan

Objective

The objective of Stage 4.1 is to develop a plan to ensure timely and appropriate generation and dissemination of project information relevant to Senior Management and manufacturing employees. The Communication Plan will define the information and communication needs of Senior Management and manufacturing employees: who needs what information, when they will need it, how it will be given to them, and who is responsible to prepare and deliver this information.

Steps

1. At the earliest possible stage of the project, the ***Project Team*** must plan a SMI awareness communication to the widest possible manufacturing audience possible. This communication must be planned using the format presented in Worksheet 4.1 and it should include the benefits pursued detailed in Worksheet 2.4 – SMI Scope. Senior Management must be involved in the delivery of this communication.

2. Referring to Worksheet 3.3 – Time and Cost Control, the ***Project Team*** must plan the communication of key achievements or critical signs of progress such as Project Milestones. A high degree of Senior Management involvement is desired.

3. Once the implementation project has been completed, the ***Project Team*** should communicate a summary of key achievements and strategic benefits obtained to the widest possible manufacturing audience. It should be planned using Worksheet 4.1a.

4. If the ***Project Team*** notices an early indication of underachievement against any of the benefits agreed in Worksheet 2.4 – SMI Scope, or faces a decision that may significantly change the Scope of the project, then it should be promptly shared with Senior Management for evaluation of Critical Decisions using Worksheet 4.1b. Senior Management will document the Decision taken in Worksheet 4.1b.

5. During the SMI implementation project the ***Project Team*** may identify an opportunity for further development of the manufacturing function that may have a positive strategic and/or financial impact. This Unintended Opportunity must be documented in Worksheet 4.1c for inclusion in future SMI prioritisation (Stage 1) carried out by Senior Management.

Worksheet 4.1a - Communication Plan

COMMUNICATION PLAN

Matter	Plan Date	Target Audience	Communication System	Responsible
SMI Awareness				
Project Milestone 1				
Project Milestone 2				
Project Milestone 3				
Other matters				
Other matters				
Other matters				
SMI Benefits achieved				

Worksheet 4.1b - SMI Critical Decision

Description & Options

Strategic/Financial objective affected

Decision

Worksheet 4.1c - Unintended Opportunity

Description & Options

Potential Strategic/Financial benefits identified

Stage	Title	
4.2	**Training Plan**	
Inputs		**Outputs**
- SMI Milestones and SMI Activities - SMI Time Control - SMI Cost Control		- SMI Training Plan

Objective

The objective of Stage 4.2 is to develop a plan to ensure timely and appropriate identification, generation and dissemination of training needs relevant to everyone in the manufacturing organisation affected by the implementation of the SMI. The Training Plan will define the training needs that are required for the successful implementation of the SMI: who needs what training, when they will need it, how it will be delivered to them, and who is responsible to prepare and deliver it. Manufacturing employees and potentially Project Team Members and Senior Management will have to be trained in how to work with the new practice, system, application or technology resulting from the implementation of the SMI.

Steps

1. At the earliest possible stage of the project and referring to Worksheet 3.3 – Time and Cost Control, the ***Project Team*** must plan the delivery of training required before, during or after the implementation of Project Activities and Project Milestones. A high degree of Senior Management involvement is desired. Every training need identified must be planned with a estimated delivery date, target audience, training system and responsible, who will usually be one of the Project Team Members. The Training Plan must be documented in Worksheet 4.2 for shared understanding of the plan and its accountability.

Worksheet 4.2 - Training Plan

TRAINING PLAN

Training need identified	Plan Date	Target Audience	Training System	Responsible
Training need identified 1				
Training need identified 2				
Training need identified 3				
Training need identified 4				
Training need identified 5				
Training need identified 6				
Training need identified 7				
Training need identified 8				
Training need identified 9				
Training need identified 10				

Stage	Title	
4.3	Technical Documentation	
Inputs		Outputs
- SMI Milestones and SMI Activities		- SMI Technical Documentation

Objective

The objective of Stage 4.3 is to make all needed documentation available to project team members, project manager, senior management and other manufacturing employees in an organised manner. Project documentation may include correspondence, memos, work results, procedures, and other technical documentation. This information should, to the extent possible and appropriate, be maintained in an organised fashion. Project team members and project manager may often maintain personal records in a project notebook.

Steps

1. All appropriate Technical Documentation must be included in this Stage and a glossary of contents should be maintained during the project life as illustrated in Worksheet 4.2.

Worksheet 4.3 – Technical Documentation

TECHNICAL DOCUMENTATION						
#	**Title**	**Description**	**Author**	**Revision**	**Last Update**	**Next Update**
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Stage	Title	
5	**Reviews**	
Inputs		**Outputs**
- Outputs from all the Stages		- Milestones Review - Implementation Process Review

Objective

The objectives of Stage 5 are to plan the Senior Management Reviews of the Project Milestones, Project Success after completion and the Project's adherence to the Implementation Process. Finally, changes to the Implementation Process will be made.

To realise this stage, the following sections will be carried out:

Stage 5.1 Deliverables Review

Stage 5.2 Implementation Process Review

Stage	Title	
5.1	**Deliverables Review**	
Inputs		**Outputs**
- Outputs from all Stages		- SMI Milestones Reviews - SMI Benefits Review

Objective

The objective of Stage 5.1 is that Senior Management reviews the Milestones of the Project and feedbacks the Project Team in their progress.

Steps

1. ***Project Manager*** presents the whole documentation included in this Workbook to Senior Management when the date planned for completion of a Milestone has been reached.

2. ***Senior Management*** reviews the documentation presented and feedbacks the Project Manager about the progress of the project in terms of Time control (including Quality control as explained in Step 2 of Stage 3.2), Cost control, Communication and Training. Senior Management formalises the Project Milestone review report as shown in Worksheet 5.1a where all the findings, suggestions and criticisms will be detailed.

3. Once the SMI implementation project has been completed, ***Project Manager*** presents the whole documentation included in this Workbook to Senior Management

4. ***Senior Management*** will use Worksheet 5.1b to review the overall success of the implementation in terms of Strategic Benefits, Financial Benefits, Duration, and Unintended Opportunities identified.

Worksheet 5.1a - SMI Milestone Review

Project milestone

Date

Project milestone review report

Time Control

Cost Control

Communication

Training

Comments

Worksheet 5.1b - SMI Benefits Review

SMI Implementation Project ______________________ **Completion Date** ________

Success of results

Strategic Benefits

1
2
3
4
5

Financial Benefits

1
2
3
4
5

Duration

Unintended Opportunities identified

1
2
3
4
5

Comments

Stage	Title	
5.2	**Implementation Process Review**	
Inputs		**Outputs**
- Outputs from all Stages		- SMI Implementation Process Review

Objective

The objective of Stage 5.2 is to evaluate once the project has been completed the Senior Management, Project Manager and Project Team's adherence to the formalised implementation process presented in this workbook and to learn from experience in order to further enhance this methodology and adapt it to the specific culture or manufacturing environment in which it is used.

Steps

1. ***Senior Management*** reviews the success and adherence of every stage of the SMI Implementation Project to this Workbook including their own contribution to the project. Every Stage and Step of the process will be evaluated based on a scale from *Deficient* to *Outstanding*, being *Satisfactory* the middle ground, as presented in Worksheets 5.2a, 5.2b, 5.2c, 5.2d, 5.2e. Senior Management will include in the *Comments* section of every Worksheet the most negative and positive areas of the implementation, and suggestions for improvement will be documented.

2. ***Project Manager*** reviews the success and adherence of every stage of the SMI Implementation Project to this Workbook including his/her own contribution to the project. Every Stage and Step of the process will be evaluated based on a scale from *Deficient* to *Outstanding*, being *Satisfactory* the middle ground, as presented in Worksheets 5.2a, 5.2b, 5.2c, 5.2d, 5.2e. The Project Manager will include in the *Comments* section of every Worksheet the most negative and positive areas of the implementation, and suggestions for improvement will be documented.

3. ***Project Team Members*** review the success and adherence of every stage of the SMI Implementation Project to this Workbook including their own contribution to the project. Every Stage and Step of the process will be evaluated based on a scale from *Deficient* to *Outstanding*, being *Satisfactory* the middle ground, as presented in Worksheets 5.2a, 5.2b, 5.2c, 5.2d, 5.2e. Project Team Members will include in the *Comments* section of every Worksheet the most negative and positive areas of the implementation, and suggestions for improvement will be documented.

4. All the reviews above will be analysed by ***Senior Management*** and appropriate changes to this Workbook will be made.

Worksheet 5.2a – Review Stage 1

Stage 1 - Strategic/Financial Benefits and estimated Timescale

Adhesion to process	Deficient	Satisfactory	Outstanding
SMI prioritisation	Deficient	Satisfactory	Outstanding
Document Strategic Benefits	Deficient	Satisfactory	Outstanding
Document Financial Benef. & Duration	Deficient	Satisfactory	Outstanding

Comments:

Worksheet 5.2b – Review Stage 2

Stage 2 - Resources and Assessments of Benefits & Duration

Adhesion to process	Deficient	Satisfactory	Outstanding
Project Manager selection	Deficient	Satisfactory	Outstanding
Project Team members selection	Deficient	Satisfactory	Outstanding
PT members secondment sheets	Deficient	Satisfactory	Outstanding
Motivation / Incentives	Deficient	Satisfactory	Outstanding
SMI Diagnosis	Deficient	Satisfactory	Outstanding
SMI Scope	Deficient	Satisfactory	Outstanding

Comments:

55

Worksheet 5.2c – Review Stage 3

Stage 3 - Activities and Control

Adhesion to process	Deficient	Satisfactory	Outstanding
Project Milestones selection	Deficient	Satisfactory	Outstanding
How-how analysis	Deficient	Satisfactory	Outstanding
Quality Control Activities	Deficient	Satisfactory	Outstanding
Activity planning and duration	Deficient	Satisfactory	Outstanding
Allocation of responsibilities	Deficient	Satisfactory	Outstanding
Cost control	Deficient	Satisfactory	Outstanding

Comments:

Worksheet 5.2d – Review Stage 4

Stage 4 - Communication and Training Plans

Adhesion to process	Deficient	Satisfactory	Outstanding
Communication plan	Deficient	Satisfactory	Outstanding
Communication Critical Decision	Deficient	Satisfactory	Outstanding
Communication Unintended Opportunities	Deficient	Satisfactory	Outstanding
Training plan	Deficient	Satisfactory	Outstanding
Communication & Training plans accuracy	Deficient	Satisfactory	Outstanding

Comments:

57

Worksheet 5.2e – Review Stage 5

Stage 5 - Review

Adhesion to process	Deficient	Satisfactory	Outstanding
Milestones reviews	Deficient	Satisfactory	Outstanding
Stage 1 Review	Deficient	Satisfactory	Outstanding
Stage 2 Review	Deficient	Satisfactory	Outstanding
Stage 3 Review	Deficient	Satisfactory	Outstanding
Stage 4 Review	Deficient	Satisfactory	Outstanding
Stage 5 Review	Deficient	Satisfactory	Outstanding

Comments: